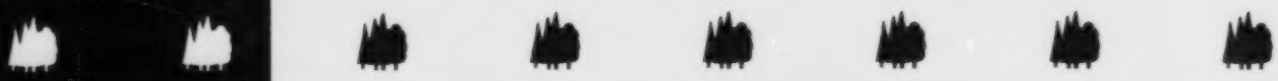
FOREST RESOURCES COMMISSION

Background Papers - Volume 5

Data on the Corporate Concentration of Harvesting Rights, Manufacturing Capacity and Ownership in the B.C. Forest Industry
- Nawitka Resource Consultants

Forest Resource Management Alternatives Study
- Fortrends Consulting, Clayton Resources Ltd., Robinson Consulting & Associates Ltd.



FOREST RESOURCES COMMISSION

Background Papers - Volume 5

Data on the Corporate Concentration of Harvesting Rights, Manufacturing Capacity and Ownership in the B.C. Forest Industry
- Nawitka Resource Consultants

Forest Resource Management Alternatives Study
- Fortrends Consulting, Clayton Resources Ltd., Robinson Consulting & Associates Ltd.

The views expressed in independent reports prepared for the Forest Resources Commission are those of the authors and not necessarily those of the Commission. They are published in their entirety for the use and interest of the public as background studies to the April 1991 Report of the Commission to the Minister of Forests.

91-04719/

DATA ON THE CORPORATE CONCENTRATION OF HARVESTING RIGHTS, MANUFACTURING CAPACITY AND OWNERSHIP IN THE B.C. FOREST INDUSTRY

Background Paper
(Revised 1991)

Prepared for: The B.C. Forest Resources Commission

Prepared by: Nawitka Resource Consultants

March 1, 1991

INTRODUCTION AND METHODOLOGY

This background paper updates and supplements a similar paper produced in January 1990. Not all tables are the same and some additional data are included in Appendices. A major difference with the previous paper is increased analyses with respect to manufacturing capacity. Also, annual manufacturing capacity has been expressed in roundwood equivalents so that capacity and harvesting have comparable units of measure.

All firms in the province having a capacity to use 50,000 m3 of wood annually were considered, as were all firms that had annual harvesting rights of 25,000 m3 or more, regardless of whether or not they had manufacturing capacity.

Firms or companies were also grouped by ownership. In general, this followed the grouping method used by the Ministry of Forests (Industry Development Branch). That is, companies that have the same parent company or major shareholder were grouped together and the group name refers to the parent company. The tables in the text were compiled largely on a group basis, but both the group and the individual company name are shown in the appendices. In some cases where complex situations existed, a common name most relevant to describing the group was used.

The reader is cautioned that a group name may not be final as to ownership or control; in effect a parent company may also have a parent company. Table 4 provides insight into this situation. In most cases it describes ownership to at least one level above the firm or group of interest in B.C.

Table 1 ranks all of the harvesting rights in B.C. as to user starting with the largest. Most of the large users are groups. For an understanding of the ownership of the group and firms included in the group, Table 4 should be consulted.

Table 2 indicates the number of firms based on five size categories utilizing the annual harvest rights.

Table 3 indicates the proportion of area based versus volume based rights in the various forest regions of the province.

Table 5 indicates whether the rights are controlled in B.C., controlled in Canada outside B.C., or foreign controlled.

Table 6 provides insight into the concentration of rights in the last 10 to 15 years.

Table 7 ranks all the companies (or groups) in B.C., from the largest to the smallest, that have solid wood products manufacturing capacity (lumber, veneer/plywood, composite board, poles and shakes and shingles). Pulp capacity, a user of chips residual to the manufacture of solid wood products, is listed separately.

Table 8 is based on Table 1 and Table 7. It compares capacity with harvesting rights for each group or firm.

The last table (9) indicates how manufacturing capacity for various products is distributed in various forest regions and summarizes the provincial totals.

Each table is accompanied by explanatory notes that assist in understanding the data as well as some comments as to interpretation.

Three Appendices are also included. These detail all the data used in the analyses. Appendix A shows the annual allowable cut by company for each forest region and timber supply area. Appendix B shows the annual manufacturing capacity for each major product by company for each region. Appendix C provides both the annual allowable cut and the manufacturing capacity for each company or group for the entire province as well as a provincial and regional summary. The last page of Appendix C details the coefficients used in converting manufactured forest products into roundwood equivalents.

Table 1. Annual Harvesting Rights in B.C., 1990

	Group/Company	Harvesting Rights (000m3)	Cumulative (000m3)	Allocation (Percent)	Cumulative (Percent)
1.	Ministry of Forests	10,797	10,797	14.5	14
2.	Noranda	10,623	21,420	14.2	29
3.	Fletcher-Challenge	8,507	29,927	11.4	40
4.	Canfor	4,966	34,893	6.7	47
5.	W. Fraser/Enso	4,208	39,101	5.6	52
6.	Weldwood	3,321	42,422	4.5	57
7.	Doman	2,759	45,181	3.7	61
8.	Slocan	2,602	47,783	3.5	64
9.	Westar	2,455	50,238	3.3	67
10.	Interfor	2,098	52,336	2.8	70
11.	C.P.	1,905	54,241	2.6	73
12.	Weyerhaeuser	1,691	55,932	2.3	75
13.	Tolko Group	1,602	57,534	2.1	77
14.	Lakeland	1,410	58,944	1.9	79
15.	Crestbrook	1,399	60,343	1.9	81
16.	Repap	1,190	61,533	1.6	82
17.	Ainsworth	1,044	62,577	1.4	84
18.	Louisiana Pacific	904	63,481	1.2	85
19.	Carrier Lumber	855	64,336	1.1	86
20.	Pope & Talbot	710	65,046	1.0	87
21.	Lignum	671	65,717	0.9	88
22.	Jacobson Bros	593	66,310	0.8	89
23.	Evans	474	66,784	0.6	89
24.	Gorman	466	67,250	0.6	90
25.	Federated Co-op	374	67,624	0.5	91
26.	Orenda	360	67,984	0.5	91
27.	Buffalo Head	360	68,344	0.5	92
28.	Riverside	347	68,691	0.5	92
29.	Terminal	308	68,999	0.4	92
30.	Husby	308	69,307	0.4	93
31.	Galloway	234	69,541	0.3	93
32.	Stuart Lake	202	69,743	0.3	93
33.	Dunkely	199	69,942	0.3	94
34.	Atco	192	70,134	0.3	94
35.	Pretty	192	70,326	0.3	94
36.	Catermole	186	70,512	0.2	94
37.	Zeidler	186	70,698	0.2	95
38.	Wedene R.	170	70,868	0.2	95
39.	Bell Pole	169	71,037	0.2	95

	Group/Company	Harvesting Rights (000m3)	Cumulative (000m3)	Committment Percent	Cumulative Percent
40.	Aspen Planers	165	71,202	0.2	95
41.	Decker Lake	145	71,347	0.2	96
42.	Tanizul	143	71,490	0.2	96
43.	Shushartie	112	71,602	0.2	96
44.	Mill & Timber	99	71,701	0.1	96
45.	Richmond Ply	95	71,796	0.1	96
46.	Hobenshield	92	71,888	0.1	96
47.	Ash River	91	71,979	0.1	96
48.	Herman/Tamihi	85	72,064	0.1	97
49.	Celcrest	80	72,144	0.1	97
50.	Huscroft	79	72,223	0.1	97
51.	Hecate	78	72,301	0.1	97
52.	Can. Chopsticks	77	72,378	0.1	97
53.	Boyle & Dean	72	72,450	0.1	97
54.	Ardew	69	72,519	0.1	97
55.	Kalesnikoff	67	72,586	0.1	97
56.	Norvik	65	72,651	0.1	97
57.	Stege	64	72,715	0.1	97
58.	Scott Paper	62	72,777	0.1	98
59.	Fitchner	60	72,837	0.1	98
60.	Moricetown Band	59	72,896	0.1	98
61.	Coulson	52	72,948	0.1	98
62.	Meadow Ck	51	72,999	0.1	98
63.	Domtar	50	73,049	0.1	98
64.	Zaul-Zap	50	73,099	0.1	98
65.	Columbia R.	48	73,147	0.1	98
66.	Mission	41	73,188	0.1	98
67.	Abfam	40	73,228	0.1	98
68.	GPL Treat	33	73,261	.0	98
69.	Lytton Log	33	73,294	.0	98
70.	Thomson	31	73,325	.0	98
71.	C&C	30	73,355	.0	98
72.	Kozek	29	73,384	.0	98
73.	CRB	27	73,411	.0	98
74.	Sitkana	27	73,438	.0	98
75.	Remco Cedar	25	73,463	.0	98
Other Small Firms (118)			1,157	1.55	100
Total All Firms (193)			74,620 AAC	100.00	100

SOURCE: Linkage and Licenses Report, MOF, Victoria, Jan 22/91
AAC 74,620; MOF Feb 7/91

Notes for Table 1

The disposition of Crown harvesting rights in B.C. is shown in Table 1. The table includes the Ministry of Forests (unallocated, allocation changes in progress, etc.) so that it represents 100 percent of the annual allowable cut for Crown regulated lands. Thus, so to speak, 192 firms (or groups of firms) plus the Ministry represent the total disposition of 74.6 million m3 of annual allowable cut. In addition to the Crown land cut, many of the firms shown also utilize some private timber. The amount of private timber cut in any one year can show considerable variation. In 1989 the cut on private land was estimated to be between 7 and 9 million m3.

Table 2. Number and Size of Firms and Harvesting Rights (1990)

Very Large Firms (9)		
(2 million m3 annually or more)	41.5 mil m3	(65%)
Large Firms (12)		
(500,000 m3 to 2 million m3 annually)	14.0 mil m3	(22%)
Medium Firms (21)		
(100 to 500,000 m3 annually)	5.3 mil m3	(8%)
Small Firms (32)		
(25 to 100,000 m3 annually)	1.9 mil m3	(3%)
Very Small Firms (118)		
(less than 25,000 m3 annually)	1.1 mil m3	(2%)
All 192 firms	63.8 mil m3	(100%)
Ministry of Forests	10.8 mil m3	
Total Crown Allocation (AAC)	74.6 mil m3	

SOURCE: Compiled from Table 1

Notes for Table 2

Table 2 indicates the number and size of firms having harvesting rights based on a five category classification from very large to very small. At the top end of the scale 9 groups control 65 percent of the harvest and at the bottom 118 firms control 2 percent of the harvest. In total, 192 firms in 1990 had harvesting rights to 63.8 million m3.

Table 3. Percent of Committed Harvesting Rights in Area versus Volume Based Tenure by Forest Region, 1990

Region	Area Based (percent)		Volume Based (percent)		Comments Does not includ 10.8 mil m3 held by Ministry of Forests
Cariboo	2		98		
Kamloops	12		88		
Nelson	27		73		
Prince George	8	(14)	92	(86)	(If PA 10&13 considered area based)
Prince Rupert	17		83		
Coast	46		54		Total rights issued only 930,000 m3
Interior	13		87		
Vancouver	64		36		Includes Mid Coast & Q.C. Islands
Province	30		70		Total allocation 63.8 mil m3
Coast	63		37		
Interior	11		89		

SOURCE: Regional Summaries of AAC

Notes for Table 3

In B.C. harvest rights can be area based or volume based. The former refers to Tree Farm Licences where only one firm has the right to harvest a specified volume from a specified area of forest land. The latter refers to other licences (mainly forest licences) where more than one firm has the right to harvest specified volumes within a very large area called a timber supply area.

Table 3 shows that area based rights are very prevalent on the Coast while volume based rights predominate in the Interior. For the province as a whole 30 percent of the harvesting rights are area based and 70 percent are volume based.

Table 4. B.C. Forest Products Industry - Major Corporate Ownership

---

Stone Container --100%---> Stone Consol. --50%---> Power Cons Pulp --50%---> Celgar Pulp
(USA)

Power Corp ----------50%-----> Power Cons. Pulp
(CDN)

China Int'l Trust Invest. ---100%---> CITI (B.C.) -------50%------> Celgar Pulp
(CHN)

Prentice & Bentley -----65%----> Canfor ---50%---> Howe Sound Pulp & Paper
Families (BC)

OJI (JPN) ----------50%----------> Howe Sound Pulp & Paper

Sauder ----100%---> Mountclair Invest. ---------35%-----> Int'l Forest Products
Holdings
(BC) ----?%-----> (Cdn. Dep. For. Sec. (Can)) ---56%---> Int'l Forest Products
(Vanpaul Co. (BC))

?% unknown but sufficient for voting control of Int'l For. Prod.

G.S. Petty -----95%----> Repap Ent. ---100%---> Skeena Cel
(CDN) (CDN)

Scott Paper Co. ---50.1% --- Scott Paper Ltd.
(USA)

Weyerhaeuser Co. ----100%----> Weyerhaeuser Can.
(USA)

Table 4 (Cont'd)

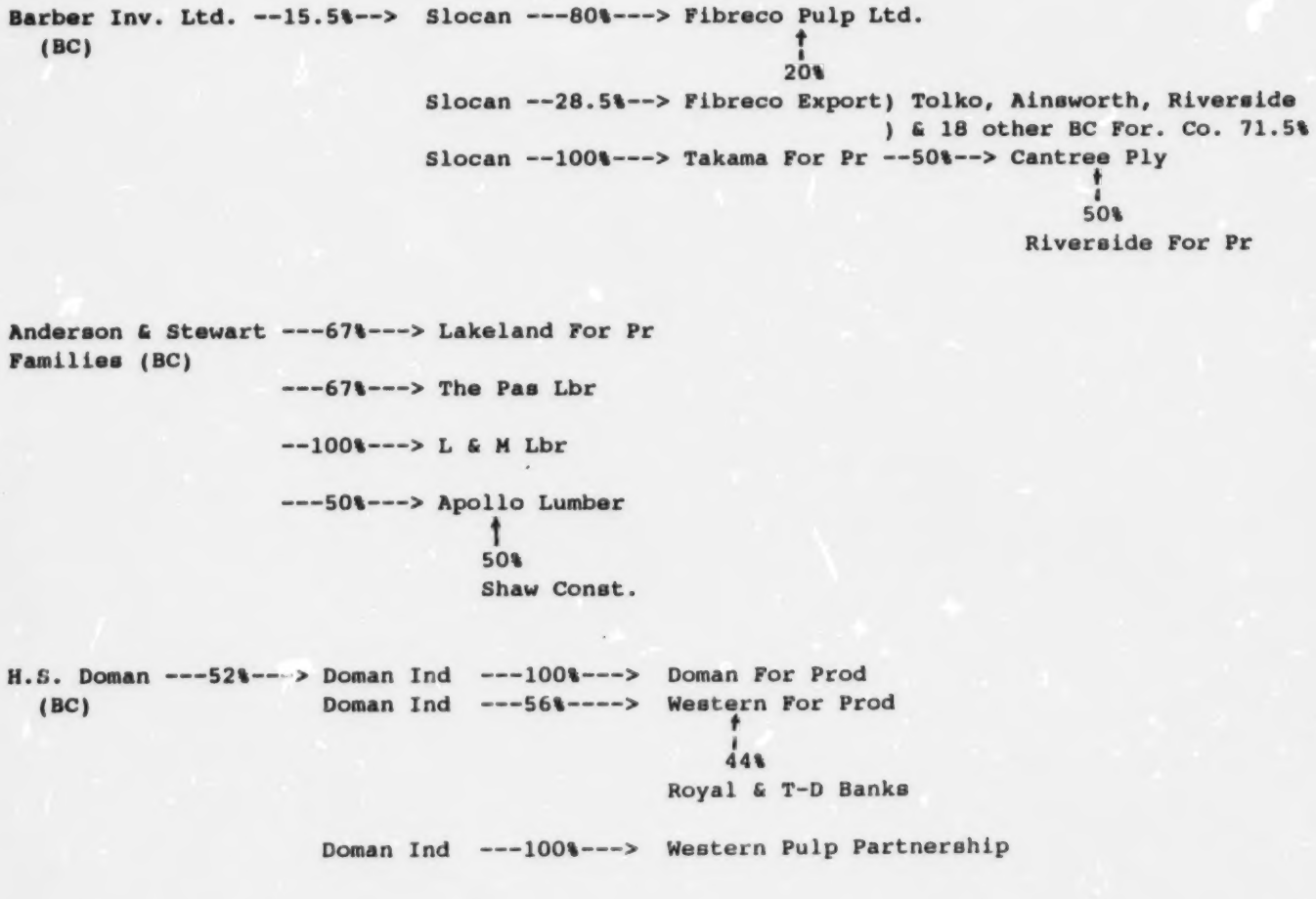

Barber Inv. Ltd. --15.5%--> Slocan ---80%---> Fibreco Pulp Ltd.
(BC)
20%
Slocan --28.5%--> Fibreco Export) Tolko, Ainsworth, Riverside
) & 18 other BC For. Co. 71.5%
Slocan --100%---> Takama For Pr --50%--> Cantree Ply
50%
Riverside For Pr
Anderson & Stewart ---67%---> Lakeland For Pr
Families (BC)
---67%---> The Pas Lbr
--100%---> L & M Lbr
---50%---> Apollo Lumber
50%
Shaw Const.
H.S. Doman ---52%---> Doman Ind ---100%---> Doman For Prod
(BC) Doman Ind ---56%----> Western For Prod
44%
Royal & T-D Banks
Doman Ind ---100%---> Western Pulp Partnership
Louisiana Pac --15%---> Doman Ind
(USA) --100%--> Louisiana Pacific Panel Prod

Table 4 (Cont'd)

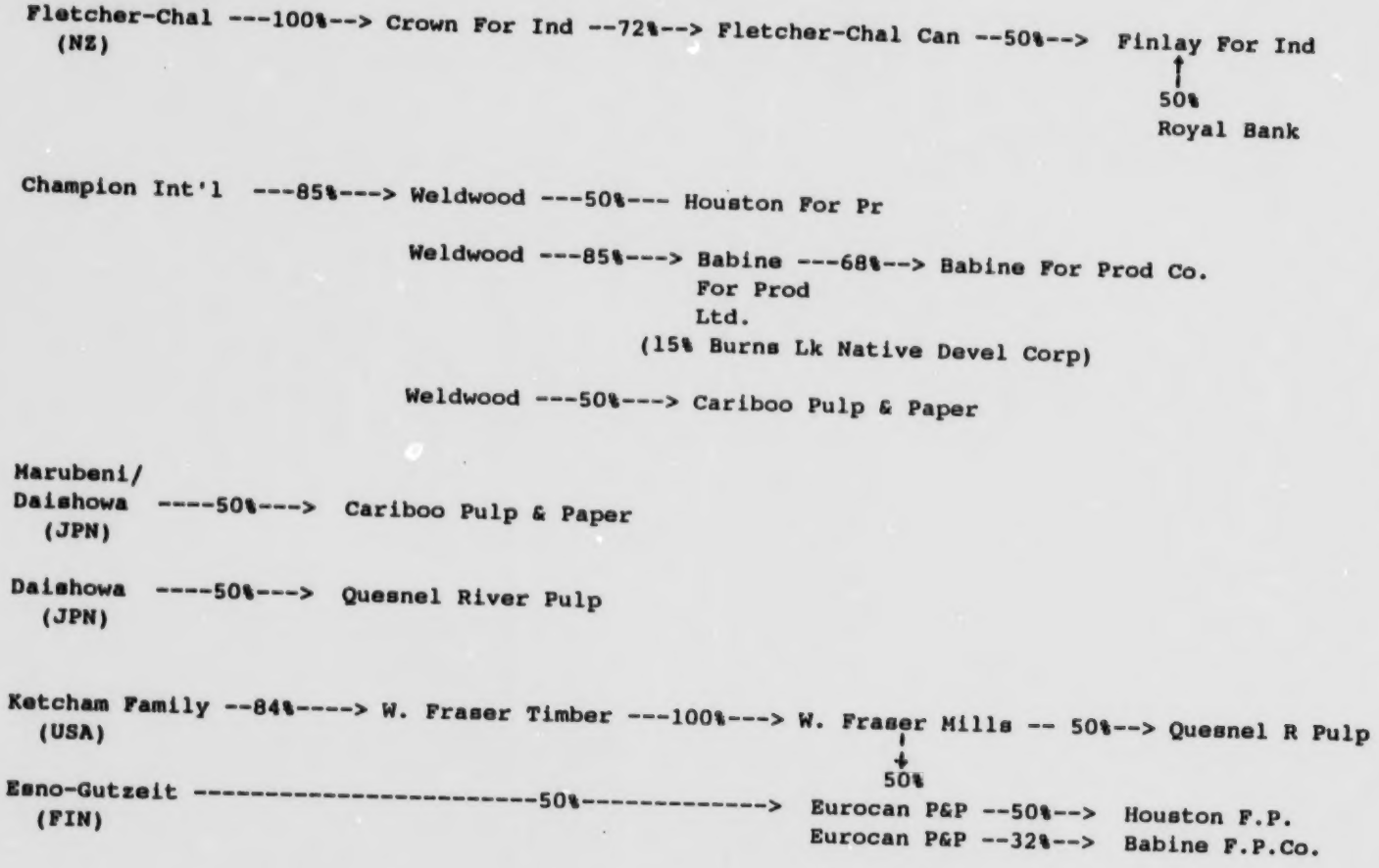
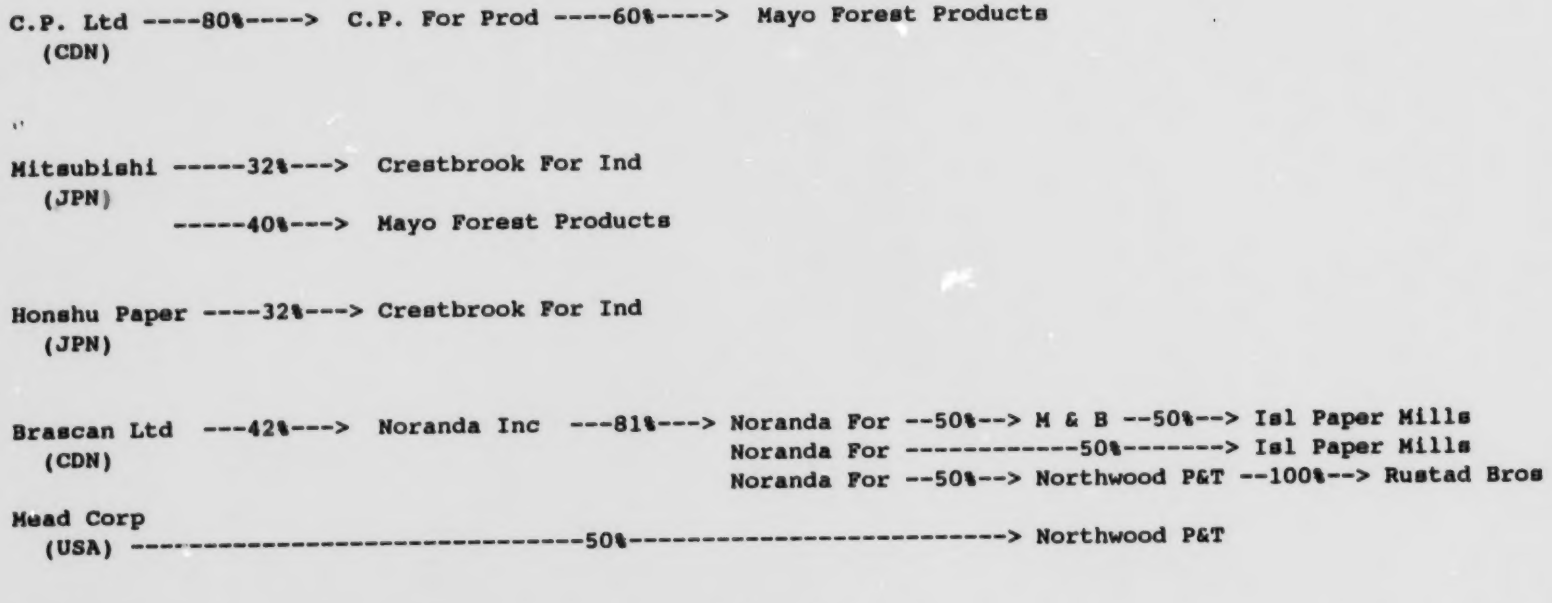

Fletcher-Chal ---100%--> Crown For Ind --72%--> Fletcher-Chal Can --50%--> Finlay For Ind
(NZ)
50%
Royal Bank
Champion Int'l ---85%---> Weldwood ---50%--- Houston For Pr
Weldwood ---85%---> Babine ---68%--> Babine For Prod Co.
For Prod
Ltd.
(15% Burns Lk Native Devel Corp)
Weldwood ---50%---> Cariboo Pulp & Paper
Marubeni/
Daishowa ----50%---> Cariboo Pulp & Paper
(JPN)
Daishowa ----50%---> Quesnel River Pulp
(JPN)
Ketcham Family --84%----> W. Fraser Timber ---100%---> W. Fraser Mills -- 50%--> Quesnel R Pulp
(USA)
50%
Esno-Gutzeit ----------50%----------> Eurocan P&P --50%--> Houston F.P.
(FIN)
Eurocan P&P --32%--> Babine F.P.Co.

Table 4 (Cont'd)


C.P. Ltd ----80%----> C.P. For Prod ----60%----> Mayo Forest Products
(CDN)
Mitsubishi -----32%---> Crestbrook For Ind
(JPN)
-----40%---> Mayo Forest Products
Honshu Paper ----32%---> Crestbrook For Ind
(JPN)
Brascan Ltd ---42%---> Noranda Inc ---81%---> Noranda For --50%--> M & B --50%--> Isl Paper Mills
(CDN)
Noranda For ----------50%-------> Isl Paper Mills
Noranda For --50%--> Northwood P&T --100%--> Rustad Bros
Mead Corp
(USA) ----------50%----------> Northwood P&T
Westar Group Ltd. --------100%--------> Westar Timber Ltd.
(BC)

SOURCE: MOF (Industry Development Branch)
The Financial Post 500, 1990
Company Annual Reports
Inquiries by the Consultant

Notes for Table 4

Major corporate ownership concerning the forest products industry is detailed for the larger firms in Table 4. In general, the company or firm of interest in B.C. was reviewed as to parent company or parent companies (i.e. joint ventures) or on the basis of major shareholders. Ownership outside of B.C. (i.e. parent companies) was not traced further than one company, unless the sources consulted listed such ownership as a matter of course. For example, Northwood Pulp and Timber Ltd. is 50% owned by Noranda Forest Inc. (Can.) which in turn is controlled by Noranda Inc. which is in turn controlled by Brascan Ltd. The other 50% interest in Northwood Pulp and Timber Ltd. is owned by Mead Corp. of Dayton, Ohio.

Table 4, in addition to identifying individual situations and ownership of the B.C. Forest industry in general, was used in the compilation of Table 5.

Table 5. Control of Crown Harvesting Rights in B.C.*

Ownership of Group or Firm	Harvesting Rights (000 m3)	Percent
United States (8)	11.4	18
Japan (1)	1.4	2
Finland (1)	1.1	2
New Zealand (1)	8.5	14
Total Foreign (11)	22.4	36
Canada (Outside B.C.) (7)	13.1	21
B.C. Companies (57)	27.2	43
Total Canadian (64)	40.3	64
TOTAL FIRMS (75)	62.7	100

* Derived from Table 1 for the 74 top firms. Apportionment increased the number of firms by one (U.S.).
Based on the firms named as Licensees; does not relate to manufacturing plant ownership. Control considered 51% ownership.
Joint ventures licenses apportioned.

Notes for Table 5

Table 5 considers the 74 firms holding 98% of the allocated annual harvesting rights on the basis of being B.C. controlled, Canadian controlled but from outside B.C., or foreign controlled. Total firms was increased to 75 as one joint venture introduced a new or unlisted U.S. firm. The table should be viewed with caution as it pertains to harvesting rights only. Manufacturing capacity would be different.

Note for instance the relatively low percentage of Japanese control of companies having harvesting rights. However, Japanese firms have a significant position in the ownership of the B.C. pulp and paper industry.

Crown regulated harvesting rights in B.C. are 36 percent controlled by 11 foreign companies, 21 percent controlled by 7 Canadian companies outside B.C. and 43 percent controlled by 57 B.C. companies.

Table 6. Trends in the Concentration of Committed Harvesting Rights

Company Group	1975	1980/81	1989	1990
Single largest	13%	11%	14%	17%
Four largest	35%	32%	41%	44%
Eight largest	53%	51%	57%	62%
Twenty largest	74%	77%	79%	86%

SOURCE: 1975 - Royal Commission, 1976, Tables B9 & 23
- Includes private land inside TFL's
1980/81 - TSA reports of the MoF
- Does not include any private land
1989 - AAC Apportionment, MoF
1990 - AAC Apportionment, MoF

Notes for Table 6

This table indicates the concentration of harvesting rights in the last 10 to 15 years. Unfortunately, the 1975 data are slightly different in that it includes the small amount of private land inside tree farm licences. It is included to show that the eight largest holders of harvesting rights did not really concentrate further from 1975 to 1980/81. Comparisons from 1980 to 1990 are based on similar data and are valid in indicating the percentage increases in concentration shown.

In the last 10 years significant concentration has occurred. Note that in general the rate of concentration increased toward the end of the period and that there is a significant difference between 1989 and 1990.

Table 7. Annual Capacity, Major Solid Wood Products and Pulp, B.C. 1989

GROUP/COMPANY	SOLID WOOD PRODUCTS RWE (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)	PULP RWE (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)
Noranda	10810	13.9	14	9226	24.6	25
Fletcher-Cha	7006	9.0	23	8879	23.7	48
Canfor	5847	7.5	30	3330	8.9	57
W. Fraser/Enso	4697	6.1	37	2500	6.7	64
Weldwood	4195	5.4	42	1711	4.6	68
Westar	3126	4.0	46	0	0.0	68
Interfor	3111	4.0	50	0	0.0	68
Slocan	3086	4.0	54	421	1.1	69
Weyerhaeuser	2824	3.6	58	2386	6.4	76
Doman	2712	3.5	61	2319	6.2	82
Ainsworth	2606	3.4	64	0	0.0	82
Tolko	2506	3.2	68	0	0.0	82
Lakeland	2288	2.9	71	0	0.0	82
C.P.	1534	2.0	73	1961	5.2	87
Crestbrook	1524	2.0	75	996	2.7	90
Repap	1385	1.8	76	2705	7.2	97
Terminal	1105	1.4	78	0	0.0	97
Carrier	937	1.2	79	0	0.0	97
Jacobson Bros	846	1.1	80	0	0.0	97
S&R Sawmills	842	1.1	81	0	0.0	97
Pope & Talbot	798	1.0	82	0	0.0	97
Lignum	705	0.9	83	0	0.0	97
Dunkley	696	0.9	84	0	0.0	97
Evans	675	0.9	85	0	0.0	97
Riverside	668	0.9	86	0	0.0	97
Primex	646	0.8	87	0	0.0	97
Gorman	567	0.7	87	0	0.0	97
Fed. Co-op	495	0.6	88	0	0.0	97
Raven	398	0.5	88	0	0.0	97
CIPA	382	0.5	89	0	0.0	97
Mill & Timber	346	0.4	89	0	0.0	97
Meeker	345	0.4	90	0	0.0	97
Atco	323	0.4	90	0	0.0	97
Norvik	314	0.4	91	0	0.0	97
Stuart Lake	278	0.4	91	0	0.0	97
Zeidler	257	0.3	91	0	0.0	97
Galloway	253	0.3	92	0	0.0	97
Wedeene	249	0.3	92	0	0.0	97
Bayside	248	0.3	92	0	0.0	97
W. Coast Cellu	248	0.3	93	0	0.0	97
Louisiana Pac	234	0.3	93	0	0.0	97
Decker Lk	229	0.3	93	0	0.0	97
Aspen Planers	209	0.3	93	0	0.0	97
Paragon	209	0.3	94	0	0.0	97
Hobenshield	199	0.3	94	0	0.0	97
Goldwood	196	0.3	94	0	0.0	97
Columbia R.	172	0.2	94	0	0.0	97
Hidden Ck	166	0.2	95	0	0.0	97
Lytton	166	0.2	95	0	0.0	97
Stege	158	0.2	95	0	0.0	97
Lindel	150	0.2	95	0	0.0	97
Scott Cedar	146	0.2	95	0	0.0	97

GROUP/COMPANY	SOLID WOOD PRODUCTS RWE (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)	PULP RWE (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)
C&C	141	0.2	96	0	0.0	97
Ardew	135	0.2	96	0	0.0	97
Delta Cedar	124	0.2	96	0	0.0	97
Pitt	124	0.2	96	0	0.0	97
Abfam	124	0.2	96	0	0.0	97
Clayton Cedar	114	0.1	96	0	0.0	97
Waldun	112	0.1	97	0	0.0	97
Blackmore	108	0.1	97	0	0.0	97
Richmond Ply	106	0.1	97	0	0.0	97
Huscroft	105	0.1	97	0	0.0	97
Lobb/Weaver	98	0.1	97	0	0.0	97
Fraser Cedar	96	0.1	97	0	0.0	97
Glenn Prop.	96	0.1	97	0	0.0	97
Island S & S	95	0.1	98	0	0.0	97
Vedder	93	0.1	98	0	0.0	97
Bell Pole	91	0.1	98	0	0.0	97
Teal Cedar	86	0.1	98	0	0.0	97
Ymir	83	0.1	98	0	0.0	97
Celcrest	83	0.1	98	0	0.0	97
Victoria Ply	82	0.1	98	0	0.0	97
Coastland	82	0.1	98	0	0.0	97
Kalesnikoff	74	0.1	98	0	0.0	97
Triple Industries	72	0.1	98	0	0.0	97
Silverdale	72	0.1	99	0	0.0	97
Woodland	70	0.1	99	0	0.0	97
Ocean Cedar	66	0.1	99	0	0.0	97
Parker Cedar	62	0.1	99	0	0.0	97
Kamloops West	61	0.1	99	0	0.0	97
Cooper Ck	61	0.1	99	0	0.0	97
Kozek	61	0.1	99	0	0.0	97
Breakwater	60	0.1	99	0	0.0	97
Goode	54	0.1	99	0	0.0	97
Northside Cedar	54	0.1	99	0	0.0	97
A & A	54	0.1	99	0	0.0	97
Giesbrecht	52	0.1	99	0	0.0	97
Q.C.I.	52	0.1	99	0	0.0	97
Creekside	52	0.1	100	0	0.0	97
Dulay	52	0.1	100	0	0.0	97
Fraser Pulp Chips	52	0.1	100	0	0.0	97
P. Soles	52	0.1	100	0	0.0	97
Can. Hobushin	52	0.1	100	0	0.0	97
Daken	50	0.1	100	0	0.0	97
Ft. Langley	50	0.1	100	0	0.0	97
Domtar	49	0.1	100	0	0.0	97
Celgar Pulp	0	0.0	100	1000	2.7	100
Scott Paper	0	0.0	100	74	0.2	100
TOTAL	77624	100		37508	100	

Note: Does not include small local mills and mills manufacturing posts or chips

Notes for Table 7

This table shows the annual manufacturing capacity of the B.C. forest products industry in roundwood equivalents. In essence, if the mills operated at capacity they would input the quantity of timber shown. Pulp is shown separately and a total is not provided for solid wood products plus pulp as the pulp industry operates largely on chips, a by-product of solid wood products manufacturing. In effect, much of the wood (chips) needed for pulp manufacture are already included in the solid wood products column.

The table ranks companies (or company groups) on the basis of capacity; largest to smallest for solid wood products. The companies shown include all the major mills in B.C. Small local operators and some smaller intermittent operators are not included.

Table 8. Annual Capacity and Harvesting Rights, Major Solid Wood Products and Pulp, B.C., 1989/90

GROUP/COMPANY	SOLID WOOD PRODUCTS RW (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)	HARVESTING RIGHTS (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)	PULP RWE (000m3)	PERCENT OF TOTAL (%)	CUMUL (%)
Noranda	10810	13.9	14	10623	17.7	18	9226	24.6	25
Fletcher-Cha	7006	9.0	23	8507	14.1	32	8879	23.7	48
Canfor	5847	7.5	30	4966	8.3	40	3330	8.9	57
W. Fraser/Enso	4697	6.1	37	4208	7.0	47	2500	6.7	64
Weldwood	4195	5.4	42	3321	5.5	53	1711	4.6	68
Westar	3126	4.0	46	2455	4.1	57	0	0.0	68
Interfor	3111	4.0	50	2098	3.5	60	0	0.0	68
Slocan	3086	4.0	54	2602	4.3	64	421	1.1	69
Weyerhaeuser	2824	3.6	58	1691	2.8	67	2386	6.4	76
Doman	2712	3.5	61	2759	4.6	72	2319	6.2	82
Ainsworth	2606	3.4	64	1044	1.7	74	0	0.0	82
Tolko	2506	3.2	68	1602	2.7	76	0	0.0	82
Lakeland	2288	2.9	71	1410	2.3	79	0	0.0	82
C.P.	1534	2.0	73	1905	3.2	82	1961	5.2	87
Crestbrook	1524	2.0	75	1399	2.3	84	996	2.7	90
Repap	1385	1.8	76	1190	2.0	86	2705	7.2	97
Terminal	1105	1.4	78	308	0.5	87	0	0.0	97
Carrier	937	1.2	79	855	1.4	88	0	0.0	97
Jacobson Bros	846	1.1	80	593	1.0	89	0	0.0	97
S&R Sawmills	842	1.1	81	0	0.0	89	0	0.0	97
Pope & Talbot	798	1.0	82	710	1.2	90	0	0.0	97
Lignum	705	0.9	83	671	1.1	91	0	0.0	97
Dunkley	696	0.9	84	199	0.3	92	0	0.0	97
Evans	675	0.9	85	474	0.8	92	0	0.0	97
Riverside	668	0.9	86	347	0.6	93	0	0.0	97
Primex	646	0.8	87	0	0.0	93	0	0.0	97
Gorman	567	0.7	87	466	0.8	94	0	0.0	97
Fed. Co-op	495	0.6	88	374	0.6	94	0	0.0	97
Raven	398	0.5	88	0	0.0	94	0	0.0	97
CIPA	382	0.5	89	0	0.0	94	0	0.0	97
Mill & Timber	346	0.4	89	99	0.2	95	0	0.0	97
Meeker	345	0.4	90	0	0.0	95	0	0.0	97
Atco	323	0.4	90	192	0.3	95	0	0.0	97
Norvik	314	0.4	91	65	0.1	95	0	0.0	97
Stuart Lake	278	0.4	91	202	0.3	95	0	0.0	97
Zeidler	257	0.3	91	186	0.3	96	0	0.0	97
Galloway	253	0.3	92	234	0.4	96	0	0.0	97
Wedeene	249	0.3	92	170	0.3	96	0	0.0	97
Bayside	248	0.3	92	0	0.0	96	0	0.0	97
W. Coast Cellu	248	0.3	93	0	0.0	96	0	0.0	97
Louisiana Pac	234	0.3	93	904	1.5	98	0	0.0	97
Decker Lk	229	0.3	93	145	0.2	98	0	0.0	97
Aspen Planers	209	0.3	93	165	0.3	98	0	0.0	97
Paragon	209	0.3	94	0	0.0	98	0	0.0	97
Hobenshield	199	0.3	94	92	0.2	98	0	0.0	97
Goldwood	196	0.3	94	0	0.0	98	0	0.0	97
Columbia R.	172	0.2	94	48	0.1	99	0	0.0	97
Hidden Ck	166	0.2	95	0	0.0	99	0	0.0	97
Lytton	166	0.2	95	33	0.1	99	0	0.0	97
Stege	158	0.2	95	64	0.1	99	0	0.0	97
Lindel	150	0.2	95	0	0.0	99	0	0.0	97
Scott Cedar	146	0.2	95	0	0.0	99	0	0.0	97

GROUP/COMPANY	PRODUCTS RW (000m3)	SOLID WOOD OF TOTAL (%)	PERCENT CUMUL (%)	RIGHTS (000m3)	HARVESTING OF TOTAL (%)	PERCENT CUMUL (%)	RWE (000m3)	PULP OF TOTAL (%)	PERCENT CUMUL (%)
C&C	141	0.2	96	30	0.0	99	0	0.0	97
Ardew	135	0.2	96	69	0.1	99	0	0.0	97
Delta Cedar	124	0.2	96	0	0.0	99	0	0.0	97
Pitt	124	0.2	96	0	0.0	99	0	0.0	97
Abfam	124	0.2	96	40	0.1	99	0	0.0	97
Clayton Cedar	114	0.1	96	0	0.0	99	0	0.0	97
Waldun	112	0.1	97	0	0.0	99	0	0.0	97
Blackmore	108	0.1	97	0	0.0	99	0	0.0	97
Richmond Ply	106	0.1	97	95	0.2	99	0	0.0	97
Huscroft	105	0.1	97	79	0.1	99	0	0.0	97
Lobb/Weaver	98	0.1	97	0	0.0	99	0	0.0	97
Fraser Cedar	96	0.1	97	0	0.0	99	0	0.0	97
Glenn Prop.	96	0.1	97	0	0.0	99	0	0.0	97
Island S & S	95	0.1	98	0	0.0	99	0	0.0	97
Vedder	93	0.1	98	0	0.0	99	0	0.0	97
Bell Pole	91	0.1	98	169	0.3	100	0	0.0	97
Teal Cedar	86	0.1	98	0	0.0	100	0	0.0	97
Ymir	83	0.1	98	0	0.0	100	0	0.0	97
Celcrest	83	0.1	98	80	0.1	100	0	0.0	97
Victoria Ply	82	0.1	98	0	0.0	100	0	0.0	97
Coastland	82	0.1	98	0	0.0	100	0	0.0	97
Kalesnikoff	74	0.1	98	67	0.1	100	0	0.0	97
Triple Industries	72	0.1	98	0	0.0	100	0	0.0	97
Silverdale	72	0.1	99	0	0.0	100	0	0.0	97
Woodland	70	0.1	99	0	0.0	100	0	0.0	97
Ocean Cedar	66	0.1	99	0	0.0	100	0	0.0	97
Parker Cedar	62	0.1	99	0	0.0	100	0	0.0	97
Kamloops West	61	0.1	99	0	0.0	100	0	0.0	97
Cooper Ck	61	0.1	99	0	0.0	100	0	0.0	97
Kozek	61	0.1	99	29	0.0	100	0	0.0	97
Breakwater	60	0.1	99	0	0.0	100	0	0.0	97
Goode	54	0.1	99	0	0.0	100	0	0.0	97
Northside Cedar	54	0.1	99	0	0.0	100	0	0.0	97
A & A	54	0.1	99	0	0.0	100	0	0.0	97
Giesbrecht	52	0.1	99	0	0.0	100	0	0.0	97
Q.C.I.	52	0.1	99	0	0.0	100	0	0.0	97
Creekside	52	0.1	100	0	0.0	100	0	0.0	97
Dulay	52	0.1	100	0	0.0	100	0	0.0	97
Fraser Pulp Chips	52	0.1	100	0	0.0	100	0	0.0	97
P. Soles	52	0.1	100	0	0.0	100	0	0.0	97
Can. Hobushin	52	0.1	100	0	0.0	100	0	0.0	97
Daken	50	0.1	100	0	0.0	100	0	0.0	97
Ft. Langley	50	0.1	100	0	0.0	100	0	0.0	97
Domtar	49	0.1	100	50	0.1	100	0	0.0	97
Celgar Pulp	0	0.0	100	0	0.0	100	1000	2.7	100
Scott Paper	0	0.0	100	62	0.1	100	74	0.2	100
TOTAL	77624	100		60146			37508	100	

Note: Does not include small local mills and mills manufacturing posts or chips

Notes for Table 8

Table 8 combines tables 1 and 7, in order to show the relative importance of Crown harvesting rights to established plant capacity. Note that the companies or groups of companies are listed by capacity and thus harvesting rights in this table would not appear in the same order as in Table 1. Also, firms without harvesting rights are included and can easily be noted by a zero entry in the harvesting rights column. In general, all very large firms and most large firms have a significant percent of their capacity covered by Crown harvesting rights. Just over half of the medium sized firms have coverage and only a few small firms have coverage.

Table 9. B.C. Regional Forest Products Manufacturing Capacities in Roundwood Equivalents, 1989* (000 m3)

REGION	LUMBER CAPACITY	PLYWOOD CAPACITY	CHIPS FROM LBR & PLY	PULP CAPACITY	POLE CAPACITY	S & S CAPACITY
Vancouver	23,530	982	9,403	18,800	158	2,692
Pr. Rupert	7,763	0	3,027	4,557	68	0
Pr. George	18,882	921	7,566	7,410	8	0
Cariboo	6,898	522	2,894	2,359	0	0
Kamloops	8,621	1,270	3,879	2,386	164	21
Nelson	6,319	404	2,668	1,996	234	211
Province	72,013	4,099	29,437	37,508	632	2,924

Total Solid Wood Products: 79,668

Total Chips for above solid products capacity: 29,437

Total Pulp Capacity: 37,508

* Chip production at stand alone chipping plants not included. Includes most but not all small local mills.

Notes for Table 9

This Table summarizes the B.C. forest products manufacturing capacity by type of product and region of manufacture. Note that chips for pulping are frequently moved from Interior sawmills to the Coast as about 50 percent of the pulp capacity is on the Coast but only about one-third of the sawmill capacity. Sawmill capacity in B.C. requires about 72 million m3 of round wood and all products (except pulp) about 80 million m3. Some 29.4 million m3 of pulpchips would be residual to the manufacture of lumber and plywood and would supply some 78 percent of the wood needs for the 37.5 million m3 of pulp capacity.

The reader is cautioned that capacity is not the same as production, and that private timber as well as other factors would have to be discussed in order to show the actual wood input, wood products output balance for B.C.

APPENDIX A - REGIONAL SUMMARIES OF THE ANNUAL ALLOWABLE CUT

The Appendix shows the annual allowable cut by company or group of companies in each major region. The quota for each license is shown and area based tenures (TFL's) are shown separately from volume based tenures. The timber supply area for each volume based license is also shown.

REGIONAL SUMMARIES - AAC

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Weldwood	Weldwood	V	TFL-38	263	TFL
Weldwood	Weldwood	V	TFL-10	219	TFL
Scott	Scott Paper	V	TFl-43	50	TFL
Noranda	M & B	V	TFL-39	3820	TFL
Noranda	M & B	V	TFL-44	2838	TFL
Indep M	Dist of Mission	V	TFL-26	41	TFL
Fletcher-Cha	Crown For	V	TFL-47	1090	TFl
Fletcher-Cha	Fletcher-Cha	V	TFL-45	305	TFL
Fletcher-Cha	Fletcher-Cha	V	TFL-46	1178	TFL
Doman Group	Western FP	V	TFL-6	1300	TFL
Doman Group	Western FP	V	TFL-25	708	TFL
Doman Group	Western FP	V	TFL-24	115	TFL
CP	CP Forest	V	TFL-19	978	TFL
Canfor	Canfor	V	TFl-37	1085	TFL
VAN REGION AREA-BASED TOTAL		63.9%	TOTAL TFL AAC	13990	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Weldwood	Weldwood	V	Sunshine C	237	FL
Terminal	Terminal FP	V	Sunshine C	55	FL
Terminal	Terminal FP	V	Sunshine C	171	FL
Interfor	International FP	V	Sunshine C	55	FL
Interfor	International FP	V	Sunshine C	265	FL
Indep. S	Hagman & Son	V	Sunshine C	14	TSL
Fletcher-Cha	Fletcher-Cha	V	Sunshine C.	218	FL
CP	CP Forest	V	Sunshine C.	46	FL
Canfor	Canfor	V	Sunshine C.	105	FL
				1166	
Weldwood	Weldwood	V	Strathcona	45	FL
Noranda	M & B	V	Strathcona	123	FL
International	International FP	V	Strathcona	282	FL
Indep. S	Raven Indust	V	Strathcona	15	TSL
Indep M	Hecate Logging	V	Strathcona	78	FL
Fletcher-Cha	Crown For	V	Strathcona	36	FL
Fletcher-Cha	Fletcher-Cha	V	Strathcona	54	FL
Doman Group	Doman Ind.	V	Strathcona	131	FL
CP	CP Forest	V	Strathcona	476	FL
Canfor	Canfor	V	Strathcona	143	FL
				1383	
Weldwood	Squamish Mills	V	Soo	18	FL
Weldwood	Weldwood	V	Soo	57	FL
Terminal	Terminal FP	V	Soo	82	FL
Scott	Scott Paper	V	Soo	5	FL
Richmond Ply	Richmond Ply	V	Soo	25	FL
Noranda	Halray L & M&B	V	Soo	26	FL
Noranda	M & B	V	Soo	18	Fl
Interfor	International FP	V	Soo	18	FL
Interfor	International FP	V	Soo	56	FL
Indep M	CRB Logging	V	Soo	27	FL
Fletcher-Cha	Fletcher-Cha	V	Soo	59	FL
Doman Group	Nanoose Log Supply	V	Soo	2	TSL
CP	CP Forest	V	Soo	80	FL
Canfor	Canfor	V	Soo	56	FL
				529	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Indep. S	QCI Sawmills	V	Queen Char	20	TSL
Indep M	Abfam Ent.	V	Queen Char	40	TSL
Indep M	Sitkana Timber	V	Queen Char	27	FL
Husby	Husby For Prod	V	Queen Char	183	FL
Husby	Naden Harbour	V	Queen Char	125	FL
Fletcher-Cha	Crown For	V	Queen Char	24	FL
				419	
Weldwood	Weldwood	V	Mid Coast	178	FL
Mill & Timber	Mill & Timber	V	Mid Coast	4	TSL
Mill & Timber	Mill & Timber	V	Mid Coast	25	FL
Interfor	International FP	V	Mid Coast	123	FL
Indep M	Ash R.	V	Mid Coast	91	TSL
Indep M	GPL Treatment	V	Mid Coast	33	FL
Fletcher-Cha	Crown For	V	Mid Coast	175	FL
Fletcher-Cha	Fletcher-Cha	V	Mid Coast	69	FL
Doman Group	Doman Inc.	V	Mid Coast	394	FL
CP	CP Forest	V	Mid Coast	181	FL
CP	Mayo	V	Mid Coast	98	FL
				1371	
Weldwood	Weldwood	V	Kingcome	221	FL
Shushartie	Shushartie Log Sales	V	Kingcome	112	FL
Scott	Scott Paper	V	Kingcome	5	FL
Richmond Ply	Richmond Ply	V	Kingcome	70	FL
Noranda	M & B	V	Kingcome	86	FL
Mill & Timber	Mill & Timber	V	Kingcome	70	FL
Interfor	International FP	V	Kingcome	586	FL
Fletcher-Cha	Fletcher-Cha	V	Kingcome	156	FL
Doman Group	Western FP	V	Kingcome	109	FL
				1415	
Scott	Scott Paper	V	Fraser	2	TSL
Pretty	Pretty's Timber	V	Fraser	192	FL
Interfor	Intern FP & Allison Pass	V	Fraser	6	TSL
Interfor	International FP	V	Fraser	230	FL
Indep. S	McMahon Lbr	V	Fraser	19	TSL
Indep M	Norvik Timber	V	Fraser	65	FL
Fletcher-Cha	Fletcher-Cha	V	Fraser	506	FL
CP	CP Forest	V	Fraser	46	FL
Catermole	Catermole	V	Fraser	186	FL
Canfor	Canfor	V	Fraser	80	FL
BRCH	Harmon/Skagit/Moon	V	Fraser	60	FL
BRCH	Tamiki	V	Fraser	25	FL
				1417	
Indep M	Coulson FP	V	Arrowsmith	52	FL
Indep. S	Texada Logging	V	Arrowsmith	14	TSL
Fletcher-Cha	Fletcher-Cha	V	Arrowsmith	145	FL
				211	
VAN REGION VOL-BASED TOTAL		36.1%	TOTAL TSA AAC:	7911	
			TFL & TSA ALLOC:	21901	

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Westar	Westar Timber	PR	TFL-51	110	TFL
W.Fraser	Enso FP/W. Fraser	PR	TFL-41	430	TFL
Repap	Skeena Cellul	PR	TFL-1	720	TFL
PR REGION AREA-BASED TOTAL	16.8%	TOTAL TFL AAC		1260	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Boyle & Dean	Boyle & Dean	PR	North Coast	22	FL
Boyle & Dean	Boyle & Dean	PR	North Coast	50	TSL
International	International FP	PR	North Coast	227	FL
Indep M	Thomson Ind.	PR	North Coast	31	FL
Wedeene	Weedene R.	PR	North Coast	170	FL
				500	
Noranda	Northwood	PG	Morice	1064	FL
W.Fraser	Enso FP/W. Fraser	PR	Morice	714	FL
				1778	
Weldwood	Babine For Pr	PR	Lakes	432	FL
Rustad Bros	Bond Bros Saw	PR	Lakes	59	FL
Decker	Decker Lk FP	PR	Lakes	145	FL
Lakeland	L & M Lbr	PG	Lakes	23	FL
W.Fraser	Enso FP/W. Fraser	PR	Lakes	367	FL
				1026	
Bell Pole	Bell Pole	PR	Kispiox	55	FL
Hobenshield	Hobenshield Bros Logging	PR	Kispiox	14	FL
Hobenshield	Kitwanga Lbr	PR	Kispiox	78	FL
Indep M	Stege Logging	PR	Kispiox	64	FL
Indep. S	S.H. Forsyth	PR	Kispiox	12	TSL
Westar	Westar Timber	PR	Kispiox	607	FL
				830	
Bell Pole	Bell Pole	PR	Kalum	14	FL
Buffalo Hd	Buffalo Hd	PR	Kalum	360	FL
W.Fraser	Eurocan P&P	PR	Kalum	28	FL
Orenda	Orenda	PR	Kalum	360	FL
Repap	Skeena Cellul	PR	Kalum	347	FL
W.Fraser	W. Fraser/Enso	PR	Kalum	266	FL
Indep M	Zaul-Zap Ind.	PR	Kalum	50	FL
				1425	
Moricetown	Morricetown Bond	PR	Bulkley	14	TSL
Moricetown	Morricetown Bond	PR	Bulkley	45	TSL
Repap	Repap Smithers Ltd	PR	Bulkley	123	FL
W.Fraser	W. Fraser	PR	Bulkley	200	TSL
W.Fraser	W. Fraser	PR	Bulkley	312	FL
				694	
PR REGION VOL-BASED TOTAL	83.2%	TOTAL TSA AAC:		6253	
		TFL & TSA ALLOC:		7513	

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Weldwood	Weldwood	C	TFL-5	110	TFL
CARIB REGION AREA-BASED TOTAL	1.6%	TOTAL TFL AAC		110	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
W.Fraser	W. Fraser	C	Williams Lk	192	FL
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	200	FL
Weldwood	Weldwood	C	Williams Lk	89	FL
Weldwood	Weldwood	C	Williams Lk	505	FL
Jacobson	Jacobson Bros	C	Williams Lk	398	FL
W.Fraser	W. Fraser	C	Williams Lk	85	FL
Jacobson	Jacobson Bros	C	Williams Lk	75	FL
W.Fraser	W. Fraser	C	Williams Lk	127	FL
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	429	FL
Lignum	Lignum Ltd.	C	Williams Lk	236	FL
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	50	TSL
Carrier	Carrier Lbr	C	Williams Lk	500	FL
Jacobson	Jacobson Bros	C	Williams Lk	120	FL
Indep M	Bruce Fitchner	C	Williams Lk	60	TSL
Lignum	Lignum Ltd.	C	Williams Lk	331	FL
			3397		
Tolko	Tolko	C	Quesnel	97	FL
Indep M	C&C Wood prd	C	Quesnel	30	FL
Canfor	Canfor	C	Quesnel	46	FL
Slocan	Slocan For Prod	C	Quesnel	382	FL
Slocan	Slocan For Prod	C	Quesnel	97	FL
Weldwood	Weldwood	C	Quesnel	20	FL
W.Fraser	W. Fraser	C	Quesnel	686	FL
Tolko	Tolko Inc.	C	Quesnel	289	FL
Weldwood	Weldwood	C	Quesnel	488	FL
W.Fraser	W. Fraser	C	Quesnel	97	FL
Fletcher-Cha	Fletcher-Cha	C	Quesnel	2	TSL
			2234		
Lignum	Lignum Ltd.	C	100 Mi Hs	104	FL
Ainsworth	Ainsworth	C	100 Mi Hs	487	FL
Weldwood	Weldwood	C	100 Mi Hs	419	FL
			1010		
CARIB REGION VOL-BASED TOTAL	98.4%	TOTAL TSA AAC:		6641	
		TFL & TSA ALLOC:		6751	

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Dunkley	Dunkley Lbr	PG	TFL-53	188	TFL
Canfor	Canfor	PG	TFL-48	410	TFL
Tanizul	Tanizul Timber	PG	TFL-42	132	TFL
Noranda	Northwood	PG	TFL-30	428	TFL
PG REGION AREA-BASED TOTAL		8.1%	TOTAL TFL AAC	1158	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Indep. S	Hauer Bros	PG	Robson Val	11	TSL
Bell Pole	Bell Pole	PG	Robson Val	10	FL
Slocan	Slocan For Prod	PG	Robson Val	175	FL
Zeidler	Zeidler	PG	Robson Val	186	FL
				382	
Lakeland	Apollo For Pr	PG	Pr.George	221	FL
Lakeland	L & M Lbr	PG	Pr.George	250	FL
Lakeland	L & M Lbr	PG	Pr.George	50	FL
Lakeland	Lakeland Mills	PG	Pr.George	262	FL
Lakeland	The Pas Lbr	PG	Pr.George	582	FL
Lakeland	The Pas Lbr	PG	Pr.George	22	FL
Lakeland	Lakeland	PG	Pr.George	22	FL
Stuart	Stuart Lk Lbr	PG	Pr.George	202	FL
Weldwood	Weldwood	PG	Pr.George	20	FL
Westar	Westar Timber	PG	Pr.George	652	FL
Canfor	Balfour	PG	Pr.George	1208	FL
Canfor	Canfor	PG	Pr.George	1030	FL
Canfor	Balfour	PG	Pr.George	22	FL
Carrier	Carrier Lbr	PG	Pr.George	78	FL
Carrier	Carrier Lbr	PG	Pr.George	266	FL
Carrier	Carrier Lbr	PG	Pr.George	22	FL
Domtar	Domtar Inc.	PG	Pr.George	50	FL
Dunkley	Dunkley	PG	Pr.George	22	FL
W.Fraser	Enso FP/W. Fraser	PG	Pr.George	261	FL
Noranda	P.G. Wood Pres	PG	Pr.George	8	TSL
Noranda	P.G. Wood Pres	PG	Pr.George	100	FL
Noranda	P.G. Wood Pres	PG	Pr.George	23	FL
Noranda	Rustad Bros	PG	Pr.George	100	FL
Noranda	Rustad Bros	PG	Pr.George	10	TSL
Noranda	Rustad Bros	PG	Pr.George	477	FL
Noranda	Rustad Bros	PG	Pr.George	4	TSL
Noranda	Rustad Bros	PG	Pr.George	23	FL
Noranda	Northwood	PG	Pr.George	1278	FL
Noranda	Northwood	PG	Pr.George	22	FL
Noranda	P.G. Wood Pres	PG	Pr.George	150	FL
Tanizul	Tanizul	PG	Pr.George	22	FL
W.Fraser	W. Fraser	PG	Pr.George	33	FL
				7492	
Fletcher-Cha	Finlay For Ind	PG	Mackenzie	1236	FL
Fletcher-Cha	Fletcher-Cha	PG	Mackenzie	1487	FL
				2723	
Canfor	Canfor	PG	Ft. St. John	414	FL
Canfor	Canfor	PG	Ft. St. John	291	FL
				705	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Indep M	Can. Chopstick	PG	Ft. Nelson	77	FL
Slocan	Tackama For Prod	PG	Ft. Nelson	145	FL
Slocan	Tackama For Prod	PG	Ft. Nelson	451	FL
Slocan	Tackama For Prod	PG	Ft. Nelson	222	FL
			895		
Louisiana Pac	Louisiana Pac	PG	Dawson Ck PA	452	PA
Canfor	Canfor	PG	Dawson Ck	87	FL
W.Fraser	W. Fraser	PG	Dawson Ck	410	FL
			949		
PG REGION VOL-BASED TOTAL		91.9%	TOTAL TSA AAC:	13146	
			TFL & TSA ALLOC:	14304	

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Weyerh	Weyer Can	K	TFL-35	130	TFL
Fed Co-op	Fed Co-op Ltd	K	TFL-33	28	TFL
Fletcher-Cha	Crown For	K	TFL-19	380	TFL
Slocan	Slocan For Prod	K	TF1-18	200	TFL
Weyerh	Weyer Can	K	TFL-15	72	TFL
KAM REGION AREA-BASED TOTAL		12.3%	TOTAL TFL AAC	810	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
Bell Pole	Bell Pole	K	Okanagan	43	FL
CMFD	Carney	K	Okanagan	14	TSL
Fletcher-Cha	Crown For	K	Okanagan	551	FL
Fed Co-op	Fed Co-op Ltd	K	Okanagan	329	FL
Gorman Bros	Gorman Bros Lbr	K	Okanagan	241	FL
Riverside	Riverside FP	K	Okanagan	291	FL
Tolko	Tolko Inc.	K	Okanagan	244	FL
Westar	Westar Timber	K	Okanagan	162	FL
Weyerh	Weyer Can	K	Okanagan	396	FL
				2271	
Ardew	Ardew Wd Pr	K	Merritt	36	FL
Ardew	Ardew Wd Pr	K	Merritt	33	TSL
Aspen	Aspen Planers	K	Merritt	32	TSL
Aspen	Aspen Planers	K	Merritt	133	FL
Fletcher-Cha	Crown For	K	Merritt	20	FL
Tolko	Tolko Inc.	K	Merritt	269	FL
Weyerh	Weyer Can	K	Merritt	569	FL
				1092	
Ainsworth	Ainsworth	K	Lillooet	348	FL
Fletcher-Cha	Fletcher-Cha	K	Lillooet	93	FL
Indep M	Lytton Lbr	K	Lillooet	33	FL
				474	
Ainsworth	Ainsworth	K	Kamloops	209	FL
Bell Pole	Bell Pole	K	Kamloops	13	FL
Fletcher-Cha	Crown For	K	Kamloops	36	FL
Fed Co-op	Fed Co-op Ltd	K	Kamloops	17	FL
Tolko	Gilbert Smith FP	K	Kamloops	62	FL
International	International FP	K	Kamloops	250	FL
Slocan	Slocan For Prod	K	Kamloops	270	FL
Tolko	Tolko Inc.	K	Kamloops	641	FL
Weyerh	Weyer Can	K	Kamloops	456	FL
				1954	
KAM REGION VOL-BASED TOTAL		87.7%	TOTAL TSA AAC:	5791	
			TFL & TSA ALLOC:	6601	

CORP GROUP	OP COMPANY	REG	TFL#	AAC 000 m3	LIC
Pope & Talbot	Pope & Talbot	N	TFL-8	275	TFL
Galloway	Galloway Lbr	N	TFL-27	27	TFL
Westar	Westar Timber	N	TFL-23	920	TFL
Crestbrook	Crestbrook	N	TFL-14	140	TFL
Slocan	Slocan For Prod	N	TFL-13	108	TFL
NELS REGION AREA-BASED TOTAL		27.3%	TOTAL TFL AAC	1470	

CORP GROUP	OP COMPANY	REG	TSA	QUOTA 000 m3	LIC
CMFD	Arrow Lk Cedar Pole	N	Revelstoke	4	TSL
Bell Pole	Bell Pole	N	Revelstoke	21	FL
Fed-Co-op	Downie St. Saw	N	Revelstoke	159	FL
Kozek	Joe Kozek Saw	N	Revelstoke	7	TSL
Kozek	Joe Kozek Saw	N	Revelstoke	21	FL
Kozek	W&S Kozek	N	Revelstoke	1	TSL
				213	
Atco	Atco Lbr	N	Kootenay Lk	25	FL
Celcrest	Celcrest/Wynndel	N	Kootenay Lk	12	FL
Celcrest	Celcrest/Wynndel	N	Kootenay Lk	68	FL
Columbia R.	Col R. S&S	N	Kootenay Lk	19	TSL
Columbia R.	Col R. S&S	N	Kootenay Lk	10	FL
Columbia R.	Col R. S&S	N	Kootenay Lk	19	TSL
Crestbrook	Crestbrook	N	Kootenay Lk	141	FL
Huscroft	Huscroft Ltd.	N	Kootenay Lk	60	FL
Huscroft	Huscroft Ltd.	N	Kootenay Lk	19	FL
Kalesnikoff	Kalesnikoff	N	Kootenay Lk	29	FL
Indep M	Meadow Ck Cedar	N	Kootenay Lk	51	FL
Remco	Remco Cedar Pr	N	Kootenay Lk	19	TSL
Remco	Remco Cedar Pr	N	Kootenay Lk	6	FL
Slocan	Slocan For Prod	N	Kootenay Lk	80	FL
Indep. S	Ymir FP	N	Kootenay Lk	24	FL
				582	
Crestbrook	Crestbrook	N	Invermere	336	FL
Slocan	Slocan For Prod	N	Invermere	255	FL
				591	
Evans	Evans Prod Co	N	Golden	474	FL
Gorman Bros	Wood River For Inc	N	Golden	62	FL
				536	
Crestbrook	Crestbrook	N	Cranbrook	641	FL
Crestbrook	Crestbrook	N	Cranbrook	141	FL
Galloway	Galloway Lbr	N	Cranbrook	73	FL
Galloway	Galloway Lbr	N	Cranbrook	94	FL
Galloway	Silver Ridge Saw	N	Cranbrook	40	FL
				989	
Fletcher-Cha	Crown For	N	Boundary	8	TSL
Gorman Bros	Gorman Bros Lbr	N	Boundary	4	TSL
Pope & Talbot	Pope & Talbot	N	Boundary	435	FL
Weyerh	Weyer Can	K	Boundary	68	FL
				515	
Atco	Atco Lbr	N	Arrow	167	FL
Bell Pole	Bell Pole	N	Arrow	13	FL
Kalesnikoff	Kalesnikoff	N	Arrow	38	FL
Riverside	Riverside FP	N	Arrow	55	FL
Slocan	Slocan For Prod	N	Arrow	218	FL
Westar	Westar Timber	N	Arrow	4	TSL
				495	
NELS REGION VOL-BASED TOTAL		72.7%	TOTAL TSA AAC:	3921	
			TFL & TSA ALLOC:	5391	

APPENDIX B - REGIONAL SUMMARIES OF ANNUAL CAPACITIES

The Appendix shows annual mill capacities by company, by region, for each major product. The capacity is shown in both product unit of measure as well as roundwood equivalent in m3. Where chips are recovered for pulping, these are also indicated in round wood equivalents. Location of the capacity "milltown" has also been noted as it could have application in assisting with the identification of forest dependent communities.

REGIONAL SUMMARIES - CAPACITIES

VANCOUVER REGION

CORP GROUP	OP COMPANY		SAWMILLS TSA#	MILL#	MILLTOWN	LUMBER =	LOGS 000m3	CHIPS RWE
Weldwood	Weldwood	V	31	467	Squamish	156 MMfbm	806	314
Weldwood	Weldwood	V	30	336	Pt Moody	82 MMfbm	424	165
Tolko	Nova Lbr Co	V	30	416	N Vancouver	82 MMfbm	424	165
Terminal	Terminal FP	V	30	396	Vancouver	65 MMfbm	336	131
Terminal	Terminal FP	V	30	540	Richmond	149 MMfbm	770	300
Noranda	M & B Ltd.	V	30	389	New Westmin	120 MMfbm	620	242
Noranda	M & B Ltd.	V	30	304	Vancouver	130 MMfbm	672	262
Noranda	M & B Ltd.	V	38	488	Nanaimo	156 MMfbm	806	314
Noranda	M & B Ltd.	V	38	488	Nanaimo	106 MMfbm	548	214
Noranda	M & B Ltd.	V	37	392	Pt Alberni	91 MMfbm	470	183
Noranda	M & B Ltd.	V	37	528	Pt Alberni	185 MMfbm	956	373
Noranda	M & B Ltd.	V	38	393	Chemainus	72 MMfbm	372	145
Noranda	M & B Ltd.	V	39	486	Powell R	55 MMfbm	284	111
Mill & Timber	Mill & Timber Prod	V	30	403	Surrey	67 MMfbm	346	135
Interfor	Bay F.P.	V	30	431	Pitt Meadows	120 MMfbm	620	242
Interfor	International FP	V	30	472	Whonnock	58 MMfbm	300	117
Interfor	International FP	V	30	461	New Westmin	185 MMfbm	956	373
Interfor	MacKenzie Mills	V	30	361	Surrey	72 MMfbm	372	145
Interfor	McDonald Cedar Prod	V	30	387	Ft Langley	86 MMfbm	444	173
Indep S	Canada Hobushin Lbr	V	30	0	Surrey	10 MMfbm	52	20
Indep M	Abfam	V	25	0	Pt. Clements	24 MMfbm	124	48
Indep M	Norvik Timber	V	30	298	Delta	72 MMfbm	372	145
Indep L	Bayside Saw	V	30	661	Port Mellon	48 MMfbm	248	97
Fletcher-Cha	Fletcher-Cha	V	37	330	Campbell R	77 MMfbm	398	155
Fletcher-Cha	Fletcher-Cha	V	30	297	Hammond	108 MMfbm	558	218
Fletcher-Cha	Fletcher-Cha	V	38	300	Youbou	65 MMfbm	336	131
Fletcher-Cha	Fletcher-Cha	V	30	339	New Westmin	120 MMfbm	620	242
Fletcher-Cha	Fletcher-Cha	V	30	100	Boston Bar	96 MMfbm	496	193
Domtar	Domtar Chemical Group	V	30	630	New Westmin	7 MMfbm	36	14
Doman	Doman For Prod	V	38	546	Nanaimo	156 MMfbm	806	314
Doman	Doman For Prod	V	30	437	Vancouver	72 MMfbm	372	145
Doman	Doman For Prod	V	38	410	Chemainus	43 MMfbm	222	87
Doman	Doman For Prod	V	30	436	Vancouver	127 MMfbm	656	256
Doman	Doman For Prod	V	30	435	New Westm.	98 MMfbm	506	197
Doman	Doman For Prod	V	38	376	Ladysmith	96 MMfbm	496	193
Doman	Doman For Prod	V	38	320	Cowichan Bay	132 MMfbm	682	266
CP	Canadian Pacific FP	V	38	442	Ladysmith	91 MMfbm	470	183
CP	Canadian Pacific FP	V	37	456	Thasis	110 MMfbm	568	222
CP	Mayo For Prod	V	38	531	Nanaimo	96 MMfbm	496	193
Canfor	Canadian FP Ltd.	V	30	332	Vancouver	144 MMfbm	744	290
	CIPA Lumber Co	V	38	312	Nanaimo	74 MMfbm	382	149
	Creekside For Prod	V	31	0	Pemberton	10 MMfbm	52	20
	Daken For Prod	V	31	664	Squamish	7 MMfbm	36	14
	Delta Cedar Prod	V	30	326	Delta	24 MMfbm	124	48
	Dulay Lbr Co	V	30	0	Burnaby	10 MMfbm	52	20
	Fraser Pulp Chips	V	30	538	Surrey	10 MMfbm	52	20
	Giesbrecht Sawmills	V	38	0	Alberni	10 MMfbm	52	20
	Goldwood Industries	V	30	537	Richmond	38 MMfbm	196	77
	Lamford Cedar Prod	V	38	451	Sooke	72 MMfbm	gone	gone gone
	Lindal Cedar Homes	V	30	580	Surrey	29 MMfbm	150	58
	Nagaard Sawmills	V	37	408	Pt Alberni	7 MMfbm	36	14
	Parker Cedar Prod	V	30	421	Surrey	12 MMfbm	62	24
	Pitt Timber	V	30	425	Pt Coquitlam	24 MMfbm	124	48
	Primex For Prod	V	37	334	Courtenay	48 MMfbm	248	97
	Primex For Prod	V	30	283	Delta	77 MMfbm	398	155
	QCI Sawmills	V	25	0	Masset	10 MMfbm	52	20
	Raven Lumber Ltd	V	37	434	Campbell R	77 MMfbm	398	155
	S & R Sawmills	V	30	454	Pt Kells	163 MMfbm	842	328
	Stag Timber	V	30	539	Surrey	48 MMfbm	248	97
	Westcoast Cellufibre	V	30	409	Vancouver	48 MMfbm	248	97
			SAWMILLS TOT REG CAPAC:			4627 MMfbm	23530	9177

CORP GROUP	OP COMPANY	REG	TSA#	MILL#	MILLTOWN	PLYWOOD =		LOGS 000m3	CHIPS RWE
Weldwood	Weldwood	V	30	481	Vancouver	96	MMft2	163	44
Richmond Ply	Richmond Ply	V	30	478	Richmond	62	MMft2	106	28
Noranda	M & B	V	37	477	Pt. Alberni	113	MMft2	192	52
Noranda	M & B	V	30	548	Vancouver	61	MMft2-P	98	
Fletcher-Cha	Fletcher-Cha	V	30	508	Annacis Is	108	MMft2	184	50
Canfor	Canfor Corp	V	30	536	New Westmin	29	MMft2-P	47	
	Coastland Wood Ind	V	38	244	Nanaimo	48	MMft2	82	22
	Surrey Veneer	V	30	651	Surrey	17	MMft2	29	8
	Victoria Plywood	V	38	479	Victoria	48	MMft2	82	22
					PANELMILLS TOT REG CAP:	582	MMft2	982	226

CORP GROUP	OP COMPANY	REG	TSA#	MILL#	MILLTOWN	PULP CAP. =		LOGS (000m3 RWE)
Canfor	Howe Sound P&P	V	39	484	Pt. Mellon	229	000mt	1074
CP	C P Forest Prod	V	37	492	Gold River	466	000mt	1961
Doman	Western Pulp	V	33	489	Pt Alice	162	000mt	988
Doman	Western Pulp	V	31	490	Woodfibre	242	000mt	1331
Fletcher-Cha	Fletcher-Cha	V	37	330	Duncan Bay	904	000mt	4471
Fletcher-Cha	Fletcher-Cha	V	38	483	Crofton	718	000mt	2861
Noranda	M & B	V	37	487	Pt Alberni	419	000mt	1500
Noranda	M & B	V	39	486	Powell R	671	000mt	2378
Noranda	M & B	V	38	488	Harmac	386	000mt	2162
Scott	Scott Paper	V	30	491	New Westm	28	000mt	74
					PULPMILLS TOT REG CAPAC:	4225	000mt	18800

CORP GROUP	OP COMPANY	REG	TSA#	MILL#	MILLTOWN	POLES =		LOGS (000m3 RWE)
	Chinook For Prod	V	37	556	Courtenay	24	Kpieces	18
Bell Pole	Bell Pole	V	30	566	Maple Ridge	19	Kpieces	14
	Catherwood Log Sort	V	30	0	Mission	48	Kpieces	36
	Timber Specialties	V	30	551	New Westmin	20	Kpieces	15
	McFarland Cascade Pole	V	30	611	New Westmin	17	Kpieces	13
Domtar	Domtar Chemical Group	V	30	630	New Westmin	17	Kpieces	13
	Central Val Pac P&P	V	30	677	Rosedale	48	Kpieces	36
	Island Pole & Piling	V	37	653	Royston	18	Kpieces	14
					POLE-YARDS TOT REG CAPAC:	211	Kpieces	158

CORP GROUP	OP COMPANY	REG	TSA#	MILL#	MILLTOWN	SHI/SHAKES =	LOGS (000m3 RWE)
	Valley Cedar	V	30	0	Abbotsford	34 Ksqs	19
	Top Line Products	V	30	676	Abbotsford	24 Ksqs	13
	Jaguar Shake Co	V	30	627	Abbotsford	24 Ksqs	13
	Breakwater Timber	V	30	596	Abbotsford	108 Ksqs	60
	Hargobind S&S	V	30	0	Abbotsford	48 Ksqs	27
	Assoc Cedar Products	V	30	285	Albion	67 Ksqs	37
	Starco Manufacturing	V	30	513	Albion	62 Ksqs	34
	Redwood Mills	V	30	0	Burnaby	26 Ksqs	14
	Comox Val Shakes	V	37	315	Campbell R	89 Ksqs	49
	Ocean Ced Prod	V	37	543	Campbell R	120 Ksqs	66
	Bonne Venture Ced Prod	V	37	620	Campbell R	36 Ksqs	20
	Five Star S/S	V	30	0	Clearbrook	43 Ksqs	24
	Longtree Shakes	V	30	0	Clearbrook	34 Ksqs	19
	Coal Harbour S&S	V	33	504	Coal Harbour	82 Ksqs	45
	J & D Shake & Cedar	V	38	0	Duncan	48 Ksqs	27
	BCF Shake Mill	V	38	288	Fanny bay	53 Ksqs	29
	Serpentine Cedar	V	30	591	Ft. Langley	58 Ksqs	32
	Ft Langley Ced Prod	V	30	0	Ft. Langley	91 Ksqs	50
	West Coast Saws	V	30	0	Maple Ridge	48 Ksqs	27
	R & K Cedar Prod	V	30	615	Maple Ridge	72 Ksqs	40
	Vedder R S&S	V	30	354	Maple Ridge	168 Ksqs	93
	D G Logging Ltd	V	30	628	Maple Ridge	55 Ksqs	30
	G & R Cedar	V	30	587	Matsqui	70 Ksqs	39
	Northside Cedar Prod	V	30	583	Mission	98 Ksqs	54
	Quality S&S	V	30	0	Mission	72 Ksqs	40
	Mission S & S	V	30	612	Mission	60 Ksqs	33
	Inland S&S	V	30	414	Mission	172 Ksqs	95
	Pioneer S&S	V	30	0	Mission	24 Ksqs	13
	Riverbank Industries	V	30	0	Mission	29 Ksqs	16
	S & W Shake & Shingle	V	30	455	Mission	139 Ksqs	77
	Meeker Cedar Prod	V	30	402	Mission	624 Ksqs	345
	General Cedar Prod	V	30	614	Mission	38 Ksqs	21
	Scott Ced Prod	V	30	635	Mission	264 Ksqs	146
	Prospective Shake Prod	V	30	599	Mission	89 Ksqs	49
	Silverdale Marine	V	30	0	Mission	130 Ksqs	72
	Samra Bros Ced Prod	V	30	671	Pitt Meadows	70 Ksqs	39
	R D Cedar	V	30	0	Pitt Meadows	43 Ksqs	24
	Anbrook Industries	V	30	673	Pitt Meadows	67 Ksqs	37
	Clayton Ced Prod	V	30	314	Pitt Meadows	206 Ksqs	114
	Doug English Ced Prod	V	39	625	Powell R	24 Ksqs	13
	Behan Cedar Prod	V	39	289	Powell R	41 Ksqs	23
	Star Shingle	V	37	674	Pt Alberni	53 Ksqs	29
	Pt Renfrew Ced Prod	V	38	429	Pt Renfrew	22 Ksqs	12
	Breda Cedar Corp	V	30	350	Ruskin	77 Ksqs	43
	G W Lobb/Weaver Shingle	V	30	588	Ruskin	178 Ksqs	98
	Waldun For Prod	V	30	464	Ruskin	202 Ksqs	112
	Silvermere For Prod	V	30	631	Ruskin	29 Ksqs	16
	Upstream Ced Prod	V	30	563	Ruskin	86 Ksqs	48
	Fraser Ced Prod	V	30	586	Ruskin	173 Ksqs	96
	Daken For Prod	V	31	664	Squamish	26 Ksqs	14
	Parker Ced Prod	V	30	421	Surrey	72 Ksqs	40
	Teal Cedar Prod	V	30	539	Surrey	156 Ksqs	86
	Pattar Cedar Prod	V	30	0	Surrey	72 Ksqs	40
	Windfall Cedar Prod	V	38	0	Tofino	36 Ksqs	20
	Confederate S&S	V	38	638	Youbou	41 Ksqs	23
					SHA/SHI MILLS TOT REG CAP:	4873 Ksqs	2692

PRINCE RUPERT REGION

SAWMILLS

CORP GROUP	OP COMPANY		TSA#	MILL#	MILLTOWN	LUMBER =	LOGS 000m3	CHIPS RWE
Weldwood	Babine F.P.	PR	14	213	Burns Lake	216 MMfbm	895	349
Decker	Decker Lk FP	PR	14	181	Burns Lake	48 MMfbm	199	78
W.Fraser	Eurocan P&P	PR	10	183	Terrace	163 MMfbm	676	264
Weldwood	Houston For Prod	PR	20	530	Houston	230 MMfbm	953	372
Hobenshield	Kitwanga Lbr Co	PR	12	184	Kitwanga	48 MMfbm	199	78
Noranda	Northwood P & T	PR	20	193	Houston	300 MMfbm	1606	627
Repap	Repap Smithers Ltd.	PR	3	192	Smithers	48 MMfbm	199	78
Repap	Skeena Cellul	PR	10	182	Terrace	286 MMfbm	1186	462
Indep M	Stege Logging	PR	12	558	New Hazelton	38 MMfbm	158	61
Weedene	Weedene R Contracting	PR	21	534	Pr Rupert	60 MMfbm	249	97
W.Fraser	West Fraser Mills	PR	3	191	Smithers	166 MMfbm	688	268
Westar	Westar Industries	PR	12	185	Kitwanga	38 MMfbm	158	61
Westar	Westar Industries	PR	12	649	Carnaby	144 MMfbm	597	233
					SAWMILLS TOT REG CAPAC:	1785 MMfbm	7763	3027

PULPMILLS

						PULP CAP. =	LOGS (000m3 RWE)
W.Fraser	Eurocan P&P	PR	10	496	Kitimat	376 000mt	1852
Repap	Skeena Cellul	PR	21	494	Pr Rupert	483 000mt	2705
					PULPMILLS TOT REG CAPAC:	859 000mt	4557

POLE-YARDS

						POLES =	LOGS (000m3 RWE)
Bell Pole	Bell Pole	PR	10	517	Terrace	14 Kpieces	11
Bell Pole	Bell Pole	PR	20	569	Topley	36 Kpieces	27
Decker	Decker Lk FP	PR	14	181	Burns Lake	40 Kpieces	30
					POLE-YARDS TOT REG CAPAC:	90 Kpieces	68

PRINCE GEORGE REGION

CORP GROUP	OP COMPANY		SAWMILLS TSA#	MILL#	MILLTOWN	LUMBER =	LOGS 000m3	CHIPS RWE
Lakeland	Apollo For Pr	PG	24	137	Ft. St. James	96 MMfbm	398	155
Canfor	Canadian FP Ltd.	PG	41	127	Chetwynd	151 MMfbm	626	244
Canfor	Canadian FP Ltd.	PG	24	156	Pr. George	216 MMfbm	895	349
Canfor	Canadian FP Ltd.	PG	40	124	Taylor	154 MMfbm	638	249
Canfor	Canadian FP Ltd.	PG	24	97	Pr.George	120 MMfbm	497	194
Canfor	Canadian FP Ltd.	PG	24	133	Ft. St. James	211 MMfbm	875	341
Canfor	Canadian FP Ltd.	PG	24	160	Bear Lk	120 MMfbm	497	194
Canfor	Canadian FP Ltd.	PG	24	135	Isle Pierre	108 MMfbm	448	175
Canfor	Canadian FP Ltd.	PG	40	122	Ft. St. John	139 MMfbm	576	225
Carrier	Carrier Lbr Ltd	PG	24	150	Pr. George	168 MMfbm	696	272
W.Fraser	Chetwynd For Ind	PG	41	552	Chetwynd	144 MMfbm	597	233
Dunkley	Dunkley Lbr Ltd	PG	24	158	Strathnaver	168 MMfbm	696	272
W.Fraser	Eurocan P&P	PG	24	532	LeJac	240 MMfbm	995	388
Fletcher-Cha	Finlay For Ind Ltd	PG	16	128	Mackenzie	106 MMfbm	439	171
Fletcher-Cha	Finlay For Ind Ltd	PG	16	129	Mackenzie	86 MMfbm	357	139
Fletcher-Cha	Fletcher-Cha	PG	16	131	Mackenzie	115 MMfbm	477	186
Fletcher-Cha	Fletcher-Cha	PG	16	132	Mackenzie	125 MMfbm	518	202
Fletcher-Cha	Fletcher-Cha	PG	16	130	Mackenzie	122 MMfbm	506	197
Lakeland	L & M Lbr Ltd	PG	24	144	Vanderhoof	120 MMfbm	497	194
Lakeland	Lakeland Mills Ltd	PG	24	149	Pr George	120 MMfbm	497	194
Noranda	Northwood P & T	PG	24	151	Pr George	24 MMfbm	124	48
Noranda	Northwood P & T	PG	24	166	Pr George	170 MMfbm	878	342
Noranda	Northwood P & T	PG	24	165	Shelley	53 MMfbm	274	107
Noranda	Northwood P & T	PG	24	164	Upper FRaser	209 MMfbm	1080	421
Lakeland	Pas Lumber Co	PG	24	162	Bear Lk	216 MMfbm	895	349
Noranda	Pr.Geo Wood Pres	PG	24	571	Pr George	91 MMfbm	377	147
Noranda	Rustad Bros	PG	24	153	Pr George	312 MMfbm	1293	504
Slocan	Slocan For Prod	PG	17	173	Valemont	77 MMfbm	319	124
Stuart	Stuart Lk Lbr	PG	24	136	Ft St James	67 MMfbm	278	108
Slocan	Tackama For Prod	PG	8	121	Ft Nelson	86 MMfbm	357	139
Westar	Westar Industries	PG	24	140	Engen	264 MMfbm	1094	427
	Woodland Lumber	PG	234	672	Pr George	17 MMfbm	70	27
Zeidler	Zeidler For Ind	PG	17	169	McBride	26 MMfbm	115	
			SAWMILLS TOT REG CAPAC:			4441 MMfbm	18882	7320

						PLYWOOD =	LOGS 000m3	CHIPS RWE
Louisiana Pac	Louisiana Pac	PG	41	650	Dawson Ck	227 MMft2-P	234	72
Noranda	Northwood P&T	PG	34	151	Pr George	115 MMft2	217	67
Slocan	Tackama For Prod	PG	8	121	Ft Nelson	182 MMft2	343	106
Zeidler	Zeidler For Ind	PG	17	169	McBride	79 MMft2	128	
			PANELMILLS TOT REG CAP:			603 MMft2	921	246

						PULP CAP. =	LOGS (000m3 RWE)
Canfor	Canfor Intercon	PG	38	500	Pr George	236 000mt	1322
Canfor	Canfor PGPP	PG	37	500	Pr George	173 000mt	934
Slocan	Fibreco Pulp Inc	PG	40	0	Taylor	179 000mt	421
Fletcher-Cha	Findlay For Ind	PG	16	128	Mackenzie	155 000mt	388
Fletcher-Cha	Fletcher-Cha	PG	16	505	Mackenzie	207 000mt	1159
Noranda	Northwood P&T	PG	34	503	Pr George	569 000mt	3186
			PULPMILLS TOT REG CAPAC:			1519 000mt	7410

						POLES =	LOGS (000m3 RWE)
Bell Pole	Bell Pole	PG	17	568	Valemont	10 K pieces	8

CARIBOO REGION

CORP GROUP	OP COMPANY		SAWMILLS TSA#	MILL#	MILLTOWN	LUMBER =	LOGS 000m3	CHIPS RWE
Slocan	Slocan For Prod - B	C	26	111	Quesnel	67 MMfbm	278	108
Slocan	Slocan For Prod - A	C	26	110	Quesnel	132 MMfbm	547	213
Ainsworth	Ainsworth Lbr	C	23	214	Clinton	96 MMfbm	398	155
Weldwood	Weldwood	C	23	95	100 Mi Hs	144 MMfbm	597	233
Jacobson	Jacobson Bros FP Ltd	C	29	101	Williams Lk	204 MMfbm	846	330
W.Fraser	West Fraser Mills	C	26	113	Quesnel	89 MMfbm	369	144
Weldwood	Weldwood	C	26	112	Quesnel	101 MMfbm	419	163
Weldwood	Weldwood	C	29	105	Williams Lk	89 MMfbm	369	144
Fletcher-Cha	Fletcher-Cha	C	29	107	Williams Lk	110 MMfbm	456	178
W.Fraser	West Fraser Mills	C	29	114	Williams Lk	101 MMfbm	419	163
Ainsworth	Ainsworth Lbr	C	23	94	100 Mi Hs	115 MMfbm	477	186
Indep M	C&C Wood Prod.	C	26	562	Quesnel	34 MMfbm	141	55
Lignum	Lignum Ltd.	C	29	103	Williams Lk	170 MMfbm	705	275
Carrier	Carrier Lbr Ltd	C	5	533	Anahim Lk	58 MMfbm	240	94
Tolko	Tolko Industries	C	26	98	Quesnel	154 MMfbm	638	249
			SAWMILLS TOT REG CAPAC:			1664 MMfbm	6898	2690

						PLYWOOD =	LOGS 000m3	CHIPS RWE
Weldwood	Weldwood	C	29	105	Williams Lk	144 MMft2	224	87
Weldwood	Weldwood	C	26	112	Quesnel	192 MMft2	298	116
			PANELMILLS TOT REG CAP:			336 MMft2	522	204

						PULP CAP. =	LOGS (000m3 RWE)
Weldwood	Cariboo P & P	C	26	497	Quesnel	311 000mt	1711
W.Fraser	Quesnel River Pulp Co.	C	26	553	Quesnel	276 000mt	649
			PULPMILLS TOT REG CAPAC:			587 000mt	2359

KAMLOOPS REGION

SAWMILLS

CORP GROUP	OP COMPANY		TSA#	MILL#	MILLTOWN	LUMBER =	LOGS 000m3	CHIPS RWE
	HP Mills Kelowna	K	22	0	Kelowna	7 MMfbm	31	12
	Lytton Lumber	K	15	116	Lytton	38 MMfbm	166	66
	Paragon Ventures	K	22	665	Grindrod	48 MMfbm	209	84
	Darfield Bldg Prod	K	11	224	Darfield	7 MMfbm	31	12
Ardew	Ardew Wood Pr	K	18	207	Merritt	31 MMfbm	135	54
Fed-Co-op	Federated Co-Op Ltd	K	22	12	Canoe	72 MMfbm	314	126
Riverside	Riverside For Prod	K	22	35	Lavington	94 MMfbm	410	164
Fletcher-Cha	Fletcher-Cha	K	22	69	Lumby	48 MMfbm	209	84
Slocan	Slocan For Prod	K	11	65	Vavenby	67 MMfbm	292	117
Aspen	Aspen Planers	K	18	498	Merritt	48 MMfbm	209	84
Ainsworth	Ainsworth Lbr	K	15	115	Lillooet	79 MMfbm	344	138
Fletcher-Cha	Fletcher-Cha	K	22	67	Kelowna	120 MMfbm	523	209
Tolko	Tolko Industries	K	11	65	Louis Ck	120 MMfbm	523	209
Weyerh	Weyer Can	K	18	42	Merritt	118 MMfbm	514	206
Fletcher-Cha	Fletcher-Cha	K	22	68	Armstrong	120 MMfbm	523	209
Weyerh	Weyer Can	K	22	27	OK Falls	96 MMfbm	418	167
	Glenn Properties	K	11	66	Barriere	22 MMfbm	96	38
	Kamloops West Wood	K	11	0	Kamloops	14 MMfbm	61	24
Gorman Bros	Gorman Bros Lbr Ltd	K	22	14	Westbank	82 MMfbm	357	143
	Lakeside Tbr	K	11	597	Tappen	10 MMfbm	44	17
Weyerh	Weyer Can	K	22	41	Lumby	72 MMfbm	314	126
Weyerh	Weyer Can	K	11	74	Kamloops	91 MMfbm	397	159
Westar	Westar Industries	K	22	11	Malakwa	53 MMfbm	231	92
Tolko	Tolko Industries	K	18	25	Merritt	77 MMfbm	336	134
International	Adams Lk Lbr	K	11	70	Adams Lake	96 MMfbm	418	167
Tolko	Tolko Industries	K	22	20	Lavington	53 MMfbm	231	92
Weyerh	Weyer Can	K	18	29	Princeton	139 MMfbm	606	242
	Karr Pivu Sawmills	K	11	0	Kamloops	7 MMfbm	31	12
Weyerh	Weyer Can	K	11	75	Vavenby	132 MMfbm	575	230
Tolko	Tolko Industries	K	11	394	Heffley Ck	17 MMfbm	74	30
					SAWMILLS TOT REG CAPAC:	1978 MMfbm	8621	3448

PLYWOOD

						PLYWOOD =	LOGS 000m3	CHIPS RWE
Riverside	Riverside For Prod	K	22	35	Lavington	158 MMft2	258	103
Fed-Co-op	Federated Co-Op Ltd	K	22	12	Canoe	96 MMft2	157	63
Fletcher-Cha	Fletcher-Cha	K	22	67	Kelowna	101 MMft2	190	59
Tolko	Tolko Industries	K	18	25	Merritt	65 MMft2	122	38
Tolko	Tolko Industries	K	11	394	Heffley Ck	84 MMft2	158	49
Ainsworth	Ainsworth Lbr	K	15	115	Lillooet	89 MMft2	168	52
Fletcher-Cha	Fletcher-Cha	K	22	68	Armstrong	115 MMft2	217	67
					PANELMILLS TOT REG CAP:	708 MMft2	1270	431

PULP

						PULP CAP. =	LOGS (000m3 RWE)
Weyerh	Weyer Can	K	11	2	Kamloops	426 000mt	2386

SHI/SHAKES

						SHI/SHAKES =	LOGS (000m3 RWE)
	David Lk Cedar	K	22	576	Squilax	38 Ksqs	21

POLES

						POLES =	LOGS (000m3 RWE)
	Goode Industries Inc	K	22	607	Monte Lk	72 Kpieces	54
	A&A Post & Rail	K	11	655	Kamloops	72 Kpieces	54
CMFD	B J Carney & Co	K	11	6	Sicamous	19 K pieces	14
Gorman Bros	Gorman Bros Lbr Ltd	K	22	40	Lumby	29 K pieces	22
International	Adams Lk Lbr	K	11	70	Chase	2 K pieces	2
Bell Pole	Bell Pole	K	22	4	Lumby	24 K pieces	18
					POLE-YARDS TOT REG CAPAC:	218 Kpieces	164

NELSON REGION

CORP GROUP	OP COMPANY		TSA#	MILL#	MILLTOWN	SAWMILLS LUMBER =	LOGS 000m3 RWE	CHIPS RWE
Westar	Westar Industries	N	1	62	Castlegar	240 MMfbm	1046	418
Slocan	Radium For Prod	N	9	90	Radium Hot Sp	86 MMfbm	375	150
Slocan	Slocan For Prod	N	1	55	Slocan	132 MMfbm	575	230
Pope & Talbot	Pope & Talbot	N	2	31	Midway	89 MMfbm	388	155
Pope & Talbot	Pope & Talbot	N	2	30	Grand Forks	94 MMfbm	410	164
Kozek	Joe Kozek Saw	N	27	47	Revelstoke	14 MMfbm	61	24
Kalesnikoff	Kalesnikoff Lbr Co Ltd	N	1	50	Thrums	17 MMfbm	74	30
Indep S	Bear Lbr Co.	N	5	643	Lumberton	7 MMfbm	31	12
Indep M	Meadow Ck Cedar	N	13	603	Cooper Ck	10 MMfbm	44	17
Huscroft	J.H Huscroft Ltd.	N	13	88	Erickson	24 MMfbm	105	42
Galloway	Galloway Lbr	N	5	86	Galloway	58 MMfbm	253	101
Fed-Co-op	Downie St. Saw	N	27	45	Revelstoke	43 MMfbm	187	75
Evans	Evans Prod Co Ltd	N	7	84	Golden	7 MMfbm	31	12
Evans	Evans Prod Co Ltd	N	7	83	Donald	110 MMfbm	479	192
Crestbrook	Crestbrook For Ind Ltd	N	2	79	Canal Flats	122 MMfbm	532	213
Crestbrook	Crestbrook For Ind Ltd	N	1	82	Elko	120 MMfbm	523	209
Crestbrook	Crestbrook For Ind Ltd	N	1	80	Cranbrook	84 MMfbm	366	146
Celcrest	Wynndel Box &Lbr	N	13	93	Wynndel	19 MMfbm	83	33
Atco	Atco Lbr	N	1	53	Park Siding	36 MMfbm	157	63
Atco	Atco Lbr	N	1	51	Fruitvale	7 MMfbm	31	12
	Cooper Creek Cedar	N	13	0	Meadow Creek	14 MMfbm	61	24
	H Seel & Son	N	9	87	Edgewater	10 MMfbm	44	17
	Hidden Ck Tbr	N	1	0	Salmo	38 MMfbm	166	66
	Irus Logging	N	2	0	Beverdell	7 MMfbm	31	12
	McDonald Ranch & Lbr	N	5	197	Grasmere	7 MMfbm	31	12
	North Star Planing	N	9	199	Athalmer	7 MMfbm	31	12
	P Soles Lumber	N	9	200	Harrogate	12 MMfbm	52	21
	S & O	N	2	0	Rhone	7 MMfbm	31	12
	West Kettle Wood	N	2	0	Beaverdell	10 MMfbm	44	17
	Ymir For Prod	N	1	658	Ymir	19 MMfbm	83	33
					SAWMILLS TOT REG CAPAC:	1450 MMfbm	6319	2528

						PLYWOOD =	LOGS 000m3 RWE	CHIPS RWE
Atco	Atco Lbr	N	1	51	Fruitvale	72 MMft2	136	42
Crestbrook	Crestbrook For Ind	N	13	81	Creston	55 MMft2	104	32
Evans	Evans Prod Co Ltd	N	7	84	Golden	101 MMft2	165	66
					PANELMILLS TOT REG CAP:	228 MMft2	404	140

						PULP CAP. =	LOGS (000m3 RWE)
Crestbrook	Crestbrook For Ind	N	9	1	Skookumchuk	181 000mt	996
Power/CITI	Celgar Pulp Ltd	N	1	501	Castlegar	183 000mt	1000
					PULP MILLS TOT REG CAP:	364 000mt	1996

						SHI/SHAKES =	LOGS (000m3 RWE)
Columbia R.	Col R. S&S	N	1	238	Nakusp	312 Ksqs	172
	Goat River S&S	N	13	0	Creston	41 Ksqs	23
	Saddle Mtn Ced Prod	N	1	0	Nakusp	29 Ksqs	16
					SHA/SHI MILLS TOT REG CAP:	382 Ksqs	211.0

						POLES =	LOGS (000m3 RWE)
	Blackmore & Sons	N	13	669	Yahk	144 Kpieces	108
	Can Ced Pole Pres	N	5	648	Galloway	29 Kpieces	22
	Paterson Pole	N	1	0	Rossland	11 Kpieces	8
	Triple Industries	N	13	0	Kitchener	96 Kpieces	72
CMFD	B J Carney & Co	N	1	647	Nakusp	14 K pieces	11
Bell Pole	Bell Pole	N	27	48	Revelstoke	18 K pieces	14
					POLE-YARDS TOT REG CAPAC:	312 Kpieces	234

APPENDIX C - COMPANY SUMMARIES

This Appendix shows the data from both of the previous Appendices on the basis of company or company group. In addition to displaying the data on a company basis, a further summary for each major company is provided which indicates on a total company or company group ownership basis summary details as to public tenure, product(s) capacity and specified proportions and ratios.

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Noranda	M & B	V	Kingcome	86	FL						
Noranda	M & B	V	Soo	18	FL						
Noranda	Halray L & M&B	V	Soo	26	FL						
Noranda	M & B	V	Strathcona	123	FL						
Noranda	M & B	V	TFL-39	3820	TFL						
Noranda	M & B	V	TFL-44	2838	TFL						
Noranda	Bond Bros Saw	PR	Lakes	59	FL						
Noranda	Northwood	PR	Morice	1064	FL						
Noranda	Northwood	PG	Pr. George	1278	FL						
Noranda	PGWood/Rustad	PG	Pr. George	150	FL						
Noranda	P.G. Wood Pres	PG	Pr.George	100	FL						
Noranda	Rustad Bros	PG	Pr.George	10	TSL						
Noranda	Rustad Bros	PG	Pr.George	100	FL						
Noranda	Rustad Bros	PG	Pr.George	477	FL						
Noranda	PGWood/Rustad	PG	Pr.George	8	TSL						
Noranda	Rustad Bros	PG	Pr.George	4	TSL						
Noranda	Northwood	PG	TFL-30	428	TFL						
Noranda	M & B	V				30	548	Vancouver	61 MMft2-P	98	
Noranda	M & B	V				37	477	Pt. Alberni	113 MMft2	192	52
Noranda	Northwood P&T	PG				34	151	Pr George	115 MMft2	217	67
Noranda	M & B Ltd.	V				37	528	Pt Alberni	185 MMfbm	956	373
Noranda	M & B Ltd.	V				37	392	Pt Alberni	91 MMfbm	470	183
Noranda	M & B Ltd.	V				38	393	Chemainus	72 MMfbm	372	145
Noranda	M & B Ltd.	V				38	488	Nanaimo	156 MMfbm	806	314
Noranda	M & B Ltd.	V				30	389	New Westmin	120 MMfbm	620	242
Noranda	M & B Ltd.	V				30	304	Vancouver	130 MMfbm	672	262
Noranda	M & B Ltd.	V				39	486	Powell R	55 MMfbm	284	111
Noranda	M & B Ltd.	V				38	488	Nanaimo	106 MMfbm	548	214
Noranda	Northwood P & T	PR				20	193	Houston	300 MMfbm	1550	604
Noranda	Northwood P & T	PG				24	164	Upper FRaser	209 MMfbm	1080	421
Noranda	Northwood P & T	PG				24	166	Pr George	170 MMfbm	878	342
Noranda	Northwood P & T	PG				24	151	Pr George	24 MMfbm	124	48
Noranda	PG Wood/Rustad	PG				24	571	Pr George	91 MMfbm	377	147
Noranda	Northwood P & T	PG				24	165	Shelley	53 MMfbm	274	107
Noranda	Rustad Bros	PG				24	153	Pr George	312 MMfbm	1293	504
Noranda	M & B	V				38	488	Harmac	386 000mt	2162	
Noranda	M & B	V				39	486	Powell R	671 000mt	2378	
Noranda	M & B	V				37	487	Pt Alberni	419 000mt	1500	
Noranda	Northwood P&T	PG				34	503	Pr George	569 000mt	3186	

TOTAL PUBLIC TENURE AAC: 10589 000m3 RW — LUMBER CAPACITY 2074 MMfbm 10303
TOTAL WOOD PROD CAPACITY: 10810 000m3 RW — PANEL CAPACITY 289 MMft2 507
PROTECTED PROPORTION WP: 98.0% — PULP CAPACITY 2045 000mt 9226 4137
PROTECTED PROPORTION PULP: 44.8% OF CHIP REQMT FROM OWN MILLS
PUBLIC TENURE/TOTAL CAPACITY RATIO: 67%

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Noranda	V	6911	5018	6040	1896	138	31	75
Noranda	PR	1123	1550	0	435	72	n/a	72
Noranda	PG	2555	4243	3186	982	60	31	40

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY		LOGS RWE m3	CHIPS RWE m3
Fletcher-Cha	Fletcher-Cha	V	Arrowsmith	145	FL							
Fletcher-Cha	Fletcher-Cha	V	Fraser	506	FL							
Fletcher-Cha	Fletcher-Cha	V	Kingcome	156	FL							
Fletcher-Cha	Crown For	V	Mid Coast	175	FL							
Fletcher-Cha	Fletcher-Cha	V	Mid Coast	69	FL							
Fletcher-Cha	Crown For	V	Queen Charl	24	FL							
Fletcher-Cha	Fletcher-Cha	V	Soo	59	FL							
Fletcher-Cha	Fletcher-Cha	V	Strathcona	54	FL							
Fletcher-Cha	Crown For	V	Strathcona	36	FL							
Fletcher-Cha	Fletcher-Cha	V	Sunshine C.	218	FL							
Fletcher-Cha	Fletcher-Cha	V	TFL-45	305	TFL							
Fletcher-Cha	Fletcher-Cha	V	TFL-46	1178	TFL							
Fletcher-Cha	Crown For	V	TFL-47	1090	TFL							
Fletcher-Cha	Finlay For Ind	PG	Mackenzie	1236	FL							
Fletcher-Cha	Fletcher-Cha	PG	Mackenzie	1487	FL							
Fletcher-Cha	Crown For	N	Boundary	8	TSL							
Fletcher-Cha	Crown For	K	Kamloops	36	FL							
Fletcher-Cha	Fletcher-Cha	K	Lillooet	93	FL							
Fletcher-Cha	Crown For	K	Merritt	20	FL							
Fletcher-Cha	Crown For	K	Okanagan	551	FL							
Fletcher-Cha	Crown For	K	TFL-49	380	TFL							
Fletcher-Cha	Fletcher-Cha	C	Quesnel	2	TSL							
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	200	FL							
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	50	TSL							
Fletcher-Cha	Fletcher-Cha	C	Williams Lk	429	FL							
Fletcher-Cha	Fletcher-Cha	V				30	508	Annacis Is	108	MMft2	184	50
Fletcher-Cha	Fletcher-Cha	K				22	67	Kelowna	101	MMft2	190	59
Fletcher-Cha	Fletcher-Cha	K				22	68	Armstrong	115	MMft2	217	67
Fletcher-Cha	Fletcher-Cha	V				30	339	New Westmin	120	MMfbm	620	242
Fletcher-Cha	Fletcher-Cha	V				30	100	Boston Bar	96	MMfbm	496	193
Fletcher-Cha	Fletcher-Cha	V				38	300	Youbou	65	MMfbm	336	131
Fletcher-Cha	Fletcher-Cha	V				30	297	Hammond	108	MMfbm	558	223
Fletcher-Cha	Fletcher-Cha	V				37	330	Campbell R	77	MMfbm	398	155
Fletcher-Cha	Fletcher-Cha	PG				16	130	Mackenzie	122	MMfbm	506	197
Fletcher-Cha	Fletcher-Cha	PG				16	132	Mackenzie	125	MMfbm	518	202
Fletcher-Cha	Fletcher-Cha	PG				16	131	Mackenzie	115	MMfbm	477	186
Fletcher-Cha	Finlay For Ind Ltd	PG				16	129	Mackenzie	86	MMfbm	357	139
Fletcher-Cha	Finlay For Ind Ltd	PG				16	128	Mackenzie	106	MMfbm	439	171
Fletcher-Cha	Fletcher-Cha	K				22	68	Armstrong	120	MMfbm	523	209
Fletcher-Cha	Fletcher-Cha	K				22	67	Kelowna	120	MMfbm	523	204
Fletcher-Cha	Fletcher-Cha	K				22	69	Lumby	48	MMfbm	209	84
Fletcher-Cha	Fletcher-Cha	C				29	107	Williams Lk	110	MMfbm	456	178
Fletcher-Cha	Fletcher-Cha	V				37	330	Duncan Bay	904	000mt	4471	
Fletcher-Cha	Fletcher-Cha	V				38	483	Crofton	718	000mt	2861	
Fletcher-Cha	Findlay For Ind	PG				16	128	Mackenzie	155	000mt	388	
Fletcher-Cha	Fletcher-Cha	PG				16	505	Mackenzie	207	000mt	1159	

TOTAL PUBLIC TENURE AAC: 8507 000m3 RW
TOTAL WOOD PROD CAPACITY: 7006 000m3 RW
PROTECTED PROPORTION WP: 121.4%
PROTECTED PROPORTION PULP: 30.3% OF CHIP REQMT FROM OWN MILLS
PUBLIC TENURE/TOTAL CAPACITY RATIO: 64%

LUMBER CAPACITY	1418	MMfbm	6415								
PANEL CAPACITY	324	MMft2	591								
PULP CAPACITY	1984	000mt	8879	2691							

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Fletcher-Cha	V	4015	2408	7332	944	167	13	46
Fletcher-Cha	PG	2723	2297	1547	895	119	58	92
Fletcher-Cha	C	681	456	0	178	149	n/a	149
Fletcher-Cha	K	1080	1255	0	536	86	n/a	86
Fletcher-Cha	N	8	0	0	0	n/a	n/a	n/a

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Canfor	Canfor	C	Quesnel	46	FL						
Canfor	Canfor	PG	Ft. St. John	414	FL						
Canfor	Balfour	PG	Pr. George	1208	FL						
Canfor	Canfor	PG	TFL-48	410	TFL						
Canfor	Canfor	PG	Dawson Ck	87	FL						
Canfor	Canfor	PG	Ft. St. John	291	FL						
Canfor	Canfor	PG	Pr. George	1030	FL						
Canfor	Canfor	V	TFL-37	1085	TFL						
Canfor	Canfor	V	Fraser	80	FL						
Canfor	Canfor	V	Soo	56	FL						
Canfor	Canfor	V	Strathcona	143	FL						
Canfor	Canfor	V	Sunshine C.	105	FL						
Canfor	Canadian FP Ltd.	PG				24	97	Pr.George	120 MMfbm	497	194
Canfor	Canadian FP Ltd.	PG				40	122	Ft. St. John	139 MMfbm	576	225
Canfor	Canadian FP Ltd.	PG				40	124	Taylor	154 MMfbm	638	249
Canfor	Canadian FP Ltd.	PG				41	127	Chetwynd	151 MMfbm	626	244
Canfor	Canadian FP Ltd.	PG				24	133	Ft. St. James	211 MMfbm	875	341
Canfor	Canadian FP Ltd.	PG				24	135	Isle Pierre	108 MMfbm	448	175
Canfor	Canadian FP Ltd.	PG				24	156	Pr. George	216 MMfbm	895	349
Canfor	Canadian FP Ltd.	PG				24	160	Bear Lk	120 MMfbm	497	194
Canfor	Canadian FP Ltd.	V				30	332	Vancouver	144 MMfbm	744	290
Canfor	Canfor Intercon	PG				38	500	Pr George	236 000mt	1322	
Canfor	Canfor PGPP	PG				37	500	Pr George	173 000mt	934	
Canfor	Howe Sound P&P	V				39	484	Pt. Mellon	229 000mt	1074	
Canfor	Canfor Corp	V				30	536	New Westmin	29 MMft2-P	49	13

TOTAL PUBLIC TENURE AAC:	4955 000m3 RW	LUMBER CAPACITY	1363 MMfbm	5797	
TOTAL WOOD PROD CAPACITY:	5847 000m3 RW	PANEL CAPACITY	29 MMft2	49	
PROTECTED PROPORTION WP:	84.7%	PULP CAPACITY	638 000mt	3330	2274
PROTECTED PROPORTION PULP:	57.9% OF CHIP REQMT FROM OWN MILLS WITH TENURE				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	68%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Canfor	V	1469	793	1074	303	185	28	94
Canfor	PG	3440	5052	2256	1340	68	59	58
Canfor	C	46	0	0	0	n/a	n/a	n/a

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
W.Fraser	W. Fraser/Enso	PR	Kalum	266	FL						
W.Fraser	W. Fraser	PR	Bulkley	312	FL						
W.Fraser	W. Fraser	PR	Bulkley	200	TSL						
W.Fraser	Eurocan P&P	PR	Kalum	28	FL						
W.Fraser	Enso FP/W. Fraser	PR	TFL-41	430	TFL						
W.Fraser	Enso FP/W. Fraser	PR	Morice	714	FL						
W.Fraser	Enso FP/W. Fraser	PR	Lakes	367	FL						
W.Fraser	Enso FP/W. Fraser	PG	Pr. George	261	FL						
W.Fraser	W. Fraser	PG	Dawson Ck	410	FL						
W.Fraser	W. Fraser	PG	Pr. George	33	FL						
W.Fraser	W. Fraser	C	Williams Lk	192	FL						
W.Fraser	W. Fraser	C	Williams Lk	85	FL						
W.Fraser	W. Fraser	C	Williams Lk	127	FL						
W.Fraser	W. Fraser	C	Quesnel	97	FL						
W.Fraser	W. Fraser	C	Quesnel	686	FL						
W.Fraser	Houston FP	PR				20	530	Houston	230 MMfbm	953	372
W.Fraser	West Fraser Mills	PR				3	191	Smithers	166 MMfbm	688	268
W.Fraser	Eurocan P&P	PR				10	183	Terrace	163 MMfbm	676	264
W.Fraser	Eurocan P&P	PG				24	532	LeJac	240 MMfbm	995	388
W.Fraser	Chetwynd For Ind	PG				41	552	Chetwynd	144 MMfbm	597	233
W.Fraser	West Fraser Mills	C				26	113	Quesnel	89 MMfbm	369	144
W.Fraser	West Fraser Mills	C				29	114	Williams Lk	101 MMfbm	419	163
W.Fraser	Eurocan P&P	PR				10	496	Kitimat	376 000mt	1852	
W.Fraser	Quesnel River Pulp Co.	C				26	553	Quesnel	276 000mt	649	

TOTAL PUBLIC TENURE AAC: 4208 000m3 RW — LUMBER CAPACITY 1133 MMfbm 4697
TOTAL WOOD PROD CAPACITY: 4697 000m3 RW — PANEL CAPACITY 0 MMft2 0
PROTECTED PROPORTION WP: 89.6% — PULP CAPACITY 652 000mt 2500 1832
PROTECTED PROPORTION PULP: 65.6% OF CHIP REQMT FROM OWN MILLS WITH TENURE
PUBLIC TENURE/TOTAL CAPACITY RATIO: 76%

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
W. Fraser	PR	2317	2317	1852	904	100	49	71
W. Fraser	PG	704	1592	0	273	44	n/a	44
W. Fraser	C	1187	788	649	307	151	47	105

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY		LOGS RWE m3	CHIPS RWE m3
Weldwood	Weldwood	V	TFL-10	219	TFL							
Weldwood	Weldwood	V	Soo	57	FL							
Weldwood	Weldwood	V	TFL-38	263	TFL							
Weldwood	Weldwood	V	Mid Coast	178	FL							
Weldwood	Weldwood	V	Strathcona	45	FL							
Weldwood	Weldwood	V	Sunshine C	237	FL							
Weldwood	Squamish Mills	V	Soo	18	FL							
Weldwood	Weldwood	V	Kingcome	221	FL							
Weldwood	Babine FP	PR	Lakes	432	FL							
Weldwood	Weldwood	PG	Pr.George	20	FL							
Weldwood	Weldwood	C	Williams Lk	505	FL							
Weldwood	Weldwood	C	Quesnel	20	FL							
Weldwood	Weldwood	C	TFL-5	110	TFL							
Weldwood	Weldwood	C	Williams Lk	89	FL							
Weldwood	Weldwood	C	Quesnel	488	FL							
Weldwood	Weldwood	C	100 Mi Hs	419	FL							
Weldwood	Weldwood	C				29	105	Williams Lk	144	MMft2	224	87
Weldwood	Weldwood	V				30	481	Vancouver	96	MMft2	163	44
Weldwood	Weldwood	C				26	112	Quesnel	192	MMft2	298	116
Weldwood	Weldwood	V				31	467	Squamish	156	MMfbm	806	314
Weldwood	Weldwood	V				30	336	Pt Moody	82	MMfbm	424	165
Weldwood	Babine FP	PR				14	213	Burns Lake	216	MMfbm	895	349
Weldwood	Weldwood	C				26	112	Quesnel	101	MMfbm	419	163
Weldwood	Weldwood	C				23	95	100 Mi Hs	144	MMfbm	597	233
Weldwood	Weldwood	C				29	105	Williams Lk	89	MMfbm	369	144
Weldwood	Cariboo P & P	C				26	497	Quesnel	311	000mt	1711	

TOTAL PUBLIC TENURE AAC:	3321 000m3 RW	LUMBER CAPACITY	788 MMfbm	3510	
TOTAL WOOD PROD CAPACITY:	4195 000m3 RW	PANEL CAPACITY	432 MMft2	686	
PROTECTED PROPORTION WP:	79.2%	PULP CAPACITY	311 000mt	1711	1617
PROTECTED PROPORTION PULP:	74.8% OF CHIP REQMT FROM OWN MILLS WITH TENURE				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	72%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Weldwood	V	1238	1393	0	465	89	n/a	89
Weldwood	PR	432	895	0	168	48	n/a	48
Weldwood	C	1631	1907	1711	639	86	37	86

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Doman Group	Doman Inc.	V	Mid Coast	394	FL						
Doman Group	Doman Ind.	V	Strathcona	131	FL						
Doman Group	Nanoose Log Supply	V	Soo	2	TSL						
Doman Group	Western FP	V	TFL-25	708	TFL						
Doman Group	Western FP	V	TFL-24	115	TFL						
Doman Group	Western FP	V	TFL-6	1300	TFL						
Doman Group	Western FP	V	Kingcome	109	FL						
Doman	Doman For Prod	V				38	320	Cowichan Bay	132 MMfbm	682	266
Doman	Doman For Prod	V				38	376	Ladysmith	96 MMfbm	496	193
Doman	Doman For Prod	V				38	410	Chemainus	43 MMfbm	222	87
Doman	Doman For Prod	V				30	435	New Westm.	98 MMfbm	506	197
Doman	Doman For Prod	V				38	546	Nanaimo	156 MMfbm	806	314
Doman	Doman For Prod	V				30	436	Vancouver	127 MMfbm	656	256
Doman	Doman For Prod	V				30	437	Vancouver	72 MMfbm	372	145
Doman	Western Pulp	V				33	489	Pt Alice	162 000mt	988	
Doman	Western Pulp	V				31	490	Woodfibre	242 000mt	1331	

TOTAL PUBLIC TENURE AAC:	2759 000m3 RW	LUMBER CAPACITY	724 MMfbm	2712	
TOTAL WOOD PROD CAPACITY:	2712 000m3 RW	PANEL CAPACITY	0 MMft2	0	
PROTECTED PROPORTION WP:	101.7%	PULP CAPACITY	404 000mt	2319	1459
PROTECTED PROPORTION PULP:	62.9%OF CHIP REQMT FROM OWN MILLS				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	77%				

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Westar	Westar Timber	K	Okanagan	162	FL						
Westar	Westar Timber	N	TFL-23	920	TFL						
Westar	Westar Timber	N	Arrow	4	TSL						
Westar	Westar Timber	PG	Pr.George	652	FL						
Westar	Westar Timber	PR	TFL-51	110	TFL						
Westar	Westar Timber	PR	Kispiox	607	FL						
Westar	Westar Industries	K				22	11	Malakwa	53 MMfbm	231	92
Westar	Westar Industries	N				1	62	Castlegar	240 MMfbm	1046	418
Westar	Westar Industries	PG				24	140	Engen	264 MMfbm	1094	427
Westar	Westar Industries	PR				12	185	Kitwanga	38 MMfbm	158	61
Westar	Westar Industries	PR				12	649	Carnaby	144 MMfbm	597	233

TOTAL PUBLIC TENURE AAC:	2455 000m3 RW	LUMBER CAPACITY	739 MMfbm	3126	
TOTAL WOOD PROD CAPACITY:	3126 000m3 RW	PANEL CAPACITY	0 MMft2	0	
PROTECTED PROPORTION WP:	78.5%	PULP CAPACITY	0 000mt	0	1232
PROTECTED PROPORTION PULP:	-- OF CHIP REQMT FROM OWN MILLS WITH TENURE				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	79%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Westar	PR	717	755	0	279	95	n/a	95
Westar	PG	652	1094	0	256	60	n/a	60
Westar	K	162	231	0	64	70	n/a	70
Westar	N	924	1046	0	368	88	n/a	88

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Slocan	Slocan For Prod	C	Quesnel	382	FL						
Slocan	Slocan For Prod	C	Quesnel	97	FL						
Slocan	Slocan For Prod	K	TFL-18	200	TFL						
Slocan	Slocan For Prod	K	Kamloops	270	FL						
Slocan	Slocan For Prod	N	TFL-13	108	TFL						
Slocan	Slocan For Prod	N	Arrow	218	FL						
Slocan	Slocan For Prod	N	Invermere	255	FL						
Slocan	Slocan For Prod	N	Kootenay Lk	80	FL						
Slocan	Slocan For Prod	PG	Robson Val	175	FL						
Slocan	Tackama For Prod	PG	Ft. Nelson	451	FL						
Slocan	Tackama For Prod	PG	Ft. Nelson	222	FL						
Slocan	Tackama For Prod	PG	Ft. Nelson	145	FL						
Slocan	Slocan For Prod - B	C				26	111	Quesnel	67 MMfbm	278	108
Slocan	Slocan For Prod - A	C				26	110	Quesnel	132 MMfbm	547	213
Slocan	Slocan For Prod	K				11	65	Vavenby	67 MMfbm	292	117
Slocan	Radium For Prod	N				9	90	Radium Hot Sp	86 MMfbm	375	150
Slocan	Slocan For Prod	N				1	55	Slocan	132 MMfbm	575	230
Slocan	Slocan For Prod	PG				17	173	Valemont	77 MMfbm	319	124
Slocan	Tackama For Prod	PG				8	121	Ft Nelson	86 MMfbm	357	139
Slocan	Tackama For Prod	PG				8	121	Ft Nelson	182 MMft2	343	106
Slocan	Fibreco Pulp Inc	PG				40	0	Taylor	179 000mt	421	

TOTAL PUBLIC TENURE AAC: 2603 000m3 RW
TOTAL WOOD PROD CAPACITY: 3086 000m3 RW
PROTECTED PROPORTION WP: 84.4%
PROTECTED PROPORTION PULP: 238.3% OF CHIP REQMT FROM OWN MILLS
PUBLIC TENURE/TOTAL CAPACITY RATIO: 104%

LUMBER CAPACITY	647 MMfbm	2743	
PANEL CAPACITY	182 MMft2	343	
PULP CAPACITY	179 000mt	421	1188

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Slocan	PG	993	1019	421	369	97	85	92
Slocan	C	479	825	0	186	58	n/a	58
Slocan	K	470	292	0	117	161	n/a	161
Slocan	N	661	950	0	266	70	n/a	70

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY		LOGS RWE m3	CHIPS RWE m3
Interfor	International FP	V	Fraser	230	FL							
Interfor	Intern FP & Allison Pass	V	Fraser	6	TSL							
Interfor	International FP	V	Kingcome	586	FL							
Interfor	International FP	V	Mid Coast	123	FL							
Interfor	International FP	V	Soo	56	FL							
Interfor	International FP	V	Soo	18	FL							
Interfor	International FP	V	Strathcona	282	FL							
Interfor	International FP	V	Sunshine C	265	FL							
Interfor	International FP	V	Sunshine C	55	FL							
Interfor	International FP	PR	North Coast	227	FL							
Interfor	International FP	K	Kamloops	250	FL							
Interfor	Adams Lk Lbr	K				11	70	Chase	2	K pieces	2	
Interfor	International FP	V				30	461	New Westmin	185	MMfbm	956	373
Interfor	International FP	V				30	472	Whonnock	58	MMfbm	300	117
Interfor	Adams Lk Lbr	K				11	70	Adams Lake	96	MMfbm	418	167
Interfor	Bay F.P.	V				30	431	Pitt Meadows	120	MMfbm	620	242
Interfor	MacKenzie Mills	V				30	361	Surrey	72	MMfbm	372	145
Interfor	McDonald Cedar Prod	V				30	387	Ft Langley	86	MMfbm	444	173

TOTAL PUBLIC TENURE AAC:	2098 000m3 RW	LUMBER CAPACITY	619 MMfbm	3111	
TOTAL WOOD PROD CAPACITY:	3111 000m3 RW	PANEL CAPACITY	0 MMft2	0	
PROTECTED PROPORTION WP:	67.4%	PULP CAPACITY	0 000mt	0	1217
PROTECTED PROPORTION PULP:	-- OF CHIP REQMT FROM OWN MILLS				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	67%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Interfor	V	1621	2692	0	630	60	n/a	60
Interfor	PR	227	0	0	0	n/a	n/a	n/a
Interfor	K	250	420	0	100	60	n/a	60

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
CP	CP Forest	V	TFL-19	978	TFL						
CP	CP Forest	V	Fraser	46	FL						
CP	CP Forest	V	Mid Coast	181	FL						
CP	CP Forest	V	Strathcona	476	FL						
CP	CP Forest	V	Sunshine C.	46	FL						
CP	CP Forest	V	Soo	80	FL						
CP	Mayo	V	Mid Coast	98	FL						
CP	Canadian Pacific FP	V				38	442	Ladysmith	91 MMfbm	470	183
CP	Canadian Pacific FP	V				37	456	Thasis	110 MMfbm	568	222
CP	Mayo For Prod	V				38	531	Nanaimo	96 MMfbm	496	193
CP	C P Forest Prod	V				37	492	Gold River	466 000mt	1961	

TOTAL PUBLIC TENURE AAC: 1905 000m3 RW — LUMBER CAPACITY 297 MMfbm 1534
TOTAL WOOD PROD CAPACITY: 1534 000m3 RW — PANEL CAPACITY 0 MMft2 0
PROTECTED PROPORTION WP: 124.2% — PULP CAPACITY 466 000mt 1961 598
PROTECTED PROPORTION PULP: 30.5%OF CHIP REQMT FROM OWN MILLS
PUBLIC TENURE/TOTAL CAPACITY RATIO: 66%

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Weyerhaeuser	Weyer Can	K	TFL-15	72	TFL						
Weyerhaeuser	Weyer Can	K	TFL-35	130	TFL						
Weyerhaeuser	Weyer Can	K	Kamloops	456	FL						
Weyerhaeuser	Weyer Can	K	Merritt	569	FL						
Weyerhaeuser	Weyer Can	K	Okanagan	396	FL						
Weyerhaeuser	Weyer Can	N	Boundary	68	FL						
Weyerhaeuser	Weyer Can	K				22	27	OK Falls	96 MMfbm	418	167
Weyerhaeuser	Weyer Can	K				18	29	Princeton	139 MMfbm	606	242
Weyerhaeuser	Weyer Can	K				22	41	Lumby	72 MMfbm	314	126
Weyerhaeuser	Weyer Can	K				18	42	Merritt	118 MMfbm	314	206
Weyerhaeuser	Weyer Can	K				11	74	Kamloops	91 MMfbm	397	159
Weyerhaeuser	Weyer Can	K				11	75	Vavenby	132 MMfbm	575	230
Weyerhaeuser	Weyer Can	K				11	2	Kamloops	426 000mt	2386	

TOTAL PUBLIC TENURE AAC: 1691 000m3 RW — LUMBER CAPACITY 648 MMfbm 2824
TOTAL WOOD PROD CAPACITY: 2824 000m3 RW — PANEL CAPACITY 0 MMft2 0
PROTECTED PROPORTION WP: 59.9% — PULP CAPACITY 426 000mt 2386 1130
PROTECTED PROPORTION PULP: 28.4% OF CHIP REQMT FROM OWN MILLS WITH TENURE
PUBLIC TENURE/TOTAL CAPACITY RATIO: 37% (NOTE: PHA-HOLDER?)

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Tolko	Tolko Inc.	K	Kamloops	641	FL						
Tolko	Gilbert Smith FP	K	Kamloops	62	FL						
Tolko	Tolko Inc.	K	Merritt	269	FL						
Tolko	Tolko Inc.	K	Okanagan	244	FL						
Tolko	Tolko	C	Quesnel	97	FL						
Tolko	Tolko Inc.	C	Quesnel	289	FL						
Tolko	Nova Lbr Co	V				30	416	N Vancouver	82 MMfbm	424	165
Tolko	Tolko Industries	K				11	65	Louis Ck	120 MMfbm	523	209
Tolko	Tolko Industries	K				18	25	Merritt	77 MMfbm	336	134
Tolko	Tolko Industries	K				22	20	Lavington	53 MMfbm	231	92
Tolko	Tolko Industries	K				11	394	Heffley Ck	17 MMfbm	74	30
Tolko	Tolko Industries	C				26	98	Quesnel	154 MMfbm	638	249
Tolko	Tolko Industries	K				11	394	Heffley Ck	84 MMft2	158	49
Tolko	Tolko Industries	K				18	25	Merritt	65 MMft2	122	38

TOTAL PUBLIC TENURE AAC:	1602 000m3 RW	LUMBER CAPACITY	503 MMfbm	2226	
TOTAL WOOD PROD CAPACITY:	2506 000m3 RW	PANEL CAPACITY	149 MMft2	281	
PROTECTED PROPORTION WP:	63.9%	PULP CAPACITY	0 000mt	0	967
PROTECTED PROPORTION PULP:	-- OF CHIP REQMT FROM OWN MILLS				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	64%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Tolko	V	0	424	0	0	0	n/a	0
Tolko	C	386	638	0	149	60	n/a	60
Tolko	K	1216	1444	0	464	84	n/a	84

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Lakeland	Apollo For Pr	PG	Pr.George	221	FL						
Lakeland	L & M Lbr	PG	Pr.George	50	FL						
Lakeland	L & M Lbr	PG	Pr.George	250	FL						
Lakeland	L & M Lbr	PR	Lakes	23	FL						
Lakeland	Lakeland Mills	PG	Pr.George	262	FL						
Lakeland	The Pas Lbr	PG	Pr.George	582	FL						
Lakeland	Apollo For Pr	PG				24	137	Ft. St. James	96 MMfbm	398	155
Lakeland	L & M Lbr Ltd	PG				24	144	Vanderhoof	120 MMfbm	497	194
Lakeland	Lakeland Mills Ltd	PG				24	149	Pr George	120 MMfbm	497	194
Lakeland	Pas Lumber Co	PG				24	162	Bear Lk	216 MMfbm	895	349

TOTAL PUBLIC TENURE AAC:	1388 000m3 RW	LUMBER CAPACITY	552 MMfbm	2288	
TOTAL WOOD PROD CAPACITY:	2288 000m3 RW	PANEL CAPACITY	0 MMft2	0	
PROTECTED PROPORTION WP:	60.7%	PULP CAPACITY	0 000mt	0	892
PROTECTED PROPORTION PULP:	-- OF CHIP REQMT FROM OWN MILLS				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	61%				

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Ainsworth	Ainsworth	K	Kamloops	209	FL						
Ainsworth	Ainsworth	K	Lillooet	348	FL						
Ainsworth	Ainsworth	C	100 Mi. Hs	487	FL						
Ainsworth	Ainsworth Lbr	C				23	94	100 Mi Hs	115 MMfbm	477	186
Ainsworth	Ainsworth Lbr	K				15	115	Lillooet	79 MMfbm	344	138
Ainsworth	Ainsworth Lbr	C				23	214	Clinton	96 MMfbm	398	155
Ainsworth	Ainsworth Lbr	K				15	115	Lillooet	89 MMft2	168	52

TOTAL PUBLIC TENURE AAC:	1044 000m3 RW	LUMBER CAPACITY	379 MMfbm	1387	
TOTAL WOOD PROD CAPACITY:	2606 000m3 RW	PANEL CAPACITY	290 MMft2	1219	
PROTECTED PROPORTION WP:	40.1%	PULP CAPACITY	0 000mt	0	531
PROTECTED PROPORTION PULP:	-- OF CHIP REQMT FROM OWN MILLS				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	40%				

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Ainsworth	C	487	875	0	191	56	n/a	56
Ainsworth	K	557	512	0	190	109	n/a	109

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Crestbrook	Crestbrook	N	TFL-14	140	TFL						
Crestbrook	Crestbrook	N	Cranbrook	641	FL						
Crestbrook	Crestbrook	N	Invermere	336	FL						
Crestbrook	Crestbrook	N	Kootenay Lk	141	FL						
Crestbrook	Crestbrook	N	Cranbrook	141	FL						
Crestbrook	Crestbrook For Ind	N				13	81	Creston	55 MMft2	104	32
Crestbrook	Crestbrook For Ind Ltd	N				1	82	Elko	120 MMfbm	523	209
Crestbrook	Crestbrook For Ind Ltd	N				2	79	Canal Flats	122 MMfbm	532	213
Crestbrook	Crestbrook For Ind Ltd	N				1	80	Cranbrook	84 MMfbm	366	146
Crestbrook	Crestbrook For Ind	N				9	1	Skookumchuk	181 000mt	996	

TOTAL PUBLIC TENURE AAC:	1399 000m3 RW	LUMBER CAPACITY	326 MMfbm	1421	
TOTAL WOOD PROD CAPACITY:	1524 000m3 RW	PANEL CAPACITY	55 MMft2	104	
PROTECTED PROPORTION WP:	91.8%	PULP CAPACITY	181 000mt	996	600
PROTECTED PROPORTION PULP:	55.4% OF CHIP REQMT FROM OWN MILLS WITH TENURE				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	71%				

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Repap	Repap Smithers Ltd	PR	Bulkley	123	FL						
Repap	Skeena Cellul	PR	TFL-1	720	TFL						
Repap	Skeena Cellul	PR	Kalum	347	FL						
Repap	Repap Smithers Ltd.	PR				3	192	Smithers	48 MMfbm	199	78
Repap	Skeena Cellul	PR				10	182	Terrace	286 MMfbm	1186	462
Repap	Skeena Cellul	PR				21	494	Pr Rupert	483 000mt	2705	

TOTAL PUBLIC TENURE AAC:	1190 000m3 RW	LUMBER CAPACITY	334 MMfbm	1385	
TOTAL WOOD PROD CAPACITY:	1385 000m3 RW	PANEL CAPACITY	0 MMft2	0	
PROTECTED PROPORTION WP:	85.9%	PULP CAPACITY	483 000mt	2705	540
PROTECTED PROPORTION PULP:	17.2% OF CHIP REQMT FROM OWN MILLS WITH TENURE				
PUBLIC TENURE/TOTAL CAPACITY RATIO:	33%				

INDEP WOOD PRODUCTS

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Carrier	Carrier Lbr	C	Williams Lk	500	FL						
Carrier	Carrier Lbr	PG	Pr. George	266	FL						
Carrier	Carrier Lbr	PG	Pr. George	78	FL						
Carrier	Carrier Lbr Ltd	PG				24	150	Pr. George	168 MMfbm	696	272
Carrier	Carrier Lbr Ltd	C				5	533	Anahim Lk	58 MMfbm	240	94
			TOT TENURE	844	TENURE PROT	90%			TOT RWE	937	365

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Carrier	C	500	240	0	94	208	n/a	208
Carrier	PG	344	696	0	133	49	n/a	49

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Louisiana Pac	Louisiana Pac	PG	Dawson Ck PA	452	PA						
Louisiana Pac	Louisiana Pac	PG				41	650	Dawson Ck	227 MMft2-P	234	
			TOT TENURE	452	TENURE PROT	193%			TOT RWE	234	0
Pope & Talbot	Pope & Talbot	N	TFL-8	275	TFL						
Pope & Talbot	Pope & Talbot	N	Boundary	435	FL						
Pope & Talbot	Pope & Talbot	N				2	30	Grand Forks	94 MMfbm	410	164
Pope & Talbot	Pope & Talbot	N				2	31	Midway	89 MMfbm	388	155
			TOT TENURE	710	TENURE PROT	89%			TOT RWE	798	319
Lignum	Lignum Ltd.	C	100 Mi. Hs	104	FL						
Lignum	Lignum Ltd.	C	Williams Lk	331	FL						
Lignum	Lignum Ltd.	C	Williams Lk	236	FL						
Lignum	Lignum Ltd.	C				29	103	Williams Lk	170 MMfbm	705	275
			TOT TENURE	671	TENURE PROT	95%			TOT RWE	705	275
Jacobson	Jacobson Bros	C	Williams Lk	120	FL						
Jacobson	Jacobson Bros	C	Williams Lk	75	FL						
	Jacobson Bros	C	Williams Lk	398	FL						
Jacobson	Jacobson Bros FP Ltd	C				29	101	Williams Lk	204 MMfbm	846	330
			TOT TENURE	593	TENURE PROT	70%			TOT RWE	846	330

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Evans	Evans Prod Co	N	Golden	474	FL						
Evans	Evans Prod Co Ltd	N				7	83	Donald	110 MMfbm	479	192
Evans	Evans Prod Co Ltd	N				7	84	Golden	7 MMfbm	31	12
Evans	Evans Prod Co Ltd	N				7	84	Golden	101 MMft2	165	66
			TOT TENURE	474	TENURE PROT		70%		TOT RWE	675	270
Fed Co-op	Fed Co-op Ltd	K	TFL-33	28	TFL						
Fed Co-op	Fed Co-op Ltd	K	Kamloops	17	FL						
Fed Co-op	Fed Co-op Ltd	K	Okanagan	329	FL						
Fed-Co-op	Federated Co-Op Ltd	K				22	12	Canoe	72 MMfbm	314	126
Fed-Co-op	Federated Co-Op Ltd	K				22	12	Canoe	96 MMft2	181	54
			TOT TENURE	374	TENURE PROT		76%		TOT RWE	495	180
Galloway	Galloway Lbr	N	Cranbrook	73	FL						
Galloway	Galloway Lbr	N	TFL-27	27	TFL						
Galloway	Silver Ridge Saw	N	Cranbrook	40	FL						
Galloway	Galloway Lbr	N	Cranbrook	94	FL						
Galloway	Galloway Lbr	N				5	86	Galloway	58 MMfbm	253	101
			TOT TENURE	234	TENURE PROT		93%		TOT RWE	253	101
Gorman Bros	Gorman Bros Lbr	K	Okanagan	241	FL						
Gorman Bros	Gorman Bros Lbr	N	Boundary	4	TSL						
Gorman Bros	Wood River For Inc	N	Golden	62	FL						
Gorman Bros	Downie St. Saw	N	Revelstoke	159	FL						
Gorman Bros	Downie St. Saw	N				27	45	Revelstoke	43 MMfbm	187	75
Gorman Bros	Gorman Bros Lbr Ltd	K				22	14	Westbank	82 MMfbm	357	143
Gorman Bros	Gorman Bros Lbr Ltd	K				22	40	Lumby	29 K pieces	22	
			TOT TENURE	466	TENURE PROT		82%		TOT RWE	567	218

COMPANY	REG	AAC (000m3)	WOOD PROD CAP. (000m3)	PULP CAP. (000m3)	PROTECTED CHIPS (000m3)	PROTECTED WP %	PROTECTED PULP %	TENURE TOTAL CAP. %
Gorman	K	241	379	0	92	64	n/a	64
Gorman	N	225	187	0	75	120	n/a	120

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Stuart	Stuart Lk Lbr	PG	Pr.George	202	FL						
Stuart	Stuart Lk Lbr	PG				24	136	Ft St James	67 MMfbm	278	108
			TOT TENURE	202	TENURE PROT	73%			TOT RWE	278	108
Buffalo Hd	Buffalo Hd	PR	Kalum	360	FL						
			TOT TENURE	360	TENURE PROT	--			TOT RWE	0	
Orenda	Orenda	PR	Kalum	360	FL						
			TOT TENURE	360	TENURE PROT	--			TOT RWE	0	0
Riverside	Riverside FP	K	Okanagan	291	FL						
Riverside	Riverside FP	N	Arrow	55	FL						
Riverside	Riverside For Prod	K				22	35	Lavington	94 MMfbm	410	164
Riverside	Riverside For Prod	K				22	35	Lavington	158 MMft2	258	103
			TOT TENURE	346	TENURE PROT	52%			TOT RWE	668	267
Terminal	Terminal FP	V	Soo	82	FL						
Terminal	Terminal FP	V	Sunshine C	171	FL						
Terminal	Terminal FP	V	Sunshine C	55	FL						
Terminal	Terminal FP	V				30	396	Vancouver	65 MMfbm	336	131
Terminal	Terminal FP	V				30	540	Richmond	149 MMfbm	770	300
			TOT TENURE	226	TENURE PROT	20%			TOT RWE	1105	431
Husby	Husby For Prod	V	Queen Char	183	FL						
Husby	Naden Harbour	V	Queen Char	125	FL						
			TOT TENURE	308	TENURE PROT	--			TOT RWE	0	
Dunkley	Dunkley Lbr	PG	TFL-53	188	TFL						
Dunkley	Dunkley Lbr Ltd	PG				24	158	Strathnaver	168 MMfbm	696	272
			TOT TENURE	188	TENURE PROT	27%			TOT RWE	696	272
Atco	Atco Lbr	N	Kootney Lk	25	FL						
Atco	Atco Lbr	N	Arrow	167	FL						
Atco	Atco Lbr	N				1	51	Fruitvale	7 MMfbm	31	12
Atco	Atco Lbr	N				1	51	Fruitvale	72 MMft2	136	42
Atco	Atco Lbr	N				1	53	Park Siding	36 MMfbm	157	63
			TOT TENURE	192	TENURE PROT	59%			TOT RWE	323	117
Pretty	Pretty's Timber	V	Fraser	192	FL						
			TOT TENURE	192	TENURE PROT	--			TOT RWE	0	0

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Catermole	Catermole	V	Fraser	186	FL						
			TOT TENURE	186	TENURE PROT	--			TOT RWE	0	
Wedeene	Weedene R.	PR	North Coast	170	FL						
Wedeene	Weedene R Contracting	PR				21	534	Pr Rupert	60 MMfbm	249	97
			TOT TENURE	170	TENURE PROT	68%			TOT RWE	249	97
Zeidler	Zeidler	PG	Robson Val	186	FL						
Zeidler	Zeidler For Ind	PG				17	169	McBride	26 MMfbm	108	42
Zeidler	Zeidler For Ind	PG				17	169	McBride	79 MMft2	149	46
			TOT TENURE	186	TENURE PROT	72%			TOT RWE	257	88
Bell Pole	Bell Pole	K	Kamloops	13	FL						
Bell Pole	Bell Pole	K	Okanagan	43	FL						
Bell Pole	Bell Pole	N	Arrow	13	FL						
Bell Pole	Bell Pole	N	Revelstoke	21	FL						
Bell Pole	Bell Pole	PG	Robson Val.	10	FL						
Bell Pole	Bell Pole	PR	Kalum	14	FL						
Bell Pole	Bell Pole	PR	Kispiox	55	FL						
Bell Pole	Bell Pole	V				30	566	Maple Ridge	19 K pieces	14	
Bell Pole	Bell Pole	PR				10	517	Terrace	14 K pieces	11	
Bell Pole	Bell Pole	K				22	4	Lumby	24 K pieces	18	
Bell Pole	Bell Pole	N				27	48	Revelstoke	18 K pieces	14	
Bell Pole	Bell Pole	PG				17	568	Valemont	10 K pieces	8	
Bell Pole	Bell Pole	PR				20	569	Topley	36 K pieces	27	
			TOT TENURE	169	TENURE PROT	186%			TOT RWE	91	
Aspen	Aspen Planers	K	Merritt	32	TSL						
Aspen	Aspen Planers	K	Merritt	133	FL						
Aspen	Aspen Planers	K				18	498	Merritt	48 MMfbm	209	84
			TOT TENURE	165	TENURE PROT	79%			TOT RWE	209	84
Decker	Decker Lk FP	PR	Lakes	145	FL						
Decker	Decker Lk FP	PR				14	181	Burns Lake	48 MMfbm	199	78
Decker	Decker Lk FP	PR				14	181	Burns Lake	40 K pieces	30	
			TOT TENURE	145	TENURE PROT	63%			TOT RWE	229	78
Tanizul	Tanizul Timber	PG	TFL-42	132	TFL						
			TOT TENURE	132	TENURE PROT	--			TOT RWE	0	0
Shushartie	Shushartie Log Sales	V	Kingcome	112	FL						
			TOT TENURE	112	TENURE PROT	--			TOT RWE	0	0

INDEP WOOD PRODUCTS CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Mill & Timber	Mill & Timber	V	Kingcome	70	FL						
Mill & Timber	Mill & Timber	V	Mid Coast	25	FL						
Mill & Timber	Mill & Timber	V	Mid Coast	4	TSL						
Mill & Timber	Mill & Timber Prod	V				30	403	Surrey	67 MMfbm	346	135
			TOT TENURE	99	TENURE PROT	29%			TOT RWE	346	135
Richmond Ply	Richmond Ply	V	Kingcome	70	FL						
Richmond Ply	Richmond Ply	V	Soo	25	FL						
Richmond Ply	Richmond Ply	V				30	478	Richmond	62 MMft2	106	28
			TOT TENURE	95	TENURE PROT	90%			TOT RWE	106	28
Hobenshield	Hobenshield Bros Logging	PR	Kispiox	14	FL						
Hobenshield	Kitwanga Lbr	PR	Kispiox	78	FL						
Hobenshield	Kitwanga Lbr Co	PR				12	184	Kitwanga	48 MMfbm	199	78
			TOT TENURE	92	TENURE PROT	46%			TOT RWE	199	78
Celcrest	Celcrest/Wynndel	N	Kootney Lk	68	FL						
Celcrest	Celcrest/Wynndel	N	Kootney Lk	12	FL						
Celcrest	Wynndel Box &Lbr	N				13	93	Wynndel	19 MMfbm	83	33
			TOT TENURE	80	TENURE PROT	97%			TOT RWE	83	33
Boyle & Dean	Boyle & Dean	PR	North Coast	22	FL						
Boyle & Dean	Boyle & Dean	PR	North Coast	50	TSL						
			TOT TENURE	72	TENURE PROT	--			TOT RWE	0	
Herman-Tamihi	Herman/Skagit/Moon	V	Fraser	60	FL						
Herman-Tamihi	Tamihi	V	Fraser	25	FL						
			TOT TENURE	85	TENURE PROT	--			TOT RWE	0	
Huscroft	Huscroft Ltd.	N	Kootenay Lk	60	FL						
Huscroft	Huscroft Ltd.	N	Kootenay Lk	19	FL						
Huscroft	J.K Huscroft Ltd.	N				13	88	Erickson	24 MMfbm	105	42
			TOT TENURE	79	TENURE PROT	76%			TOT RWE	105	42
Indep L	Bayside Saw	V				30	661	Port Mellon	48 MMfbm	248	97
			TOT TENURE	0	TENURE PROT	0%			TOT RWE	248	97

CORP GROUP	OP COMPANY	REG	TSA/TFL	000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	RWE m3	RWE m3
Domtar	Domtar Inc.	PG	Pr. George	50	FL						
Domtar	Domtar Chemical Group	V				30	630	New Westmin	7 MMfbm	36	14
Domtar	Domtar Chemical Group	V				30	630	New Westmin	17 K pieces	13	
			TOT TENURE	50	TENURE PROT	102%			TOT RWE	49	14
Kalesnikoff	Kalesnikoff	N	Arrow	38	FL						
Kalesnikoff	Kalesnikoff	N	Kootenay Lk	29	FL						
Kalesnikoff	Kalesnikoff Lbr Co Ltd	N				1	50	Thrums	17 MMfbm	74	30
			TOT TENURE	67	TENURE PROT	90%			TOT RWE	74	30
Kozek	Joe Kozek Saw	N	Revelstoke	21	FL						
Kozek	Joe Kozek Saw	N	Revelstoke	7	TSL						
Kozek	W&S Kozek	N	Revelstoke	1	TSL						
Kozek	Joe Kozek Saw	N				27	47	Revelstoke	14 MMfbm	61	24
			TOT TENURE	29	TENURE PROT	48%			TOT RWE	61	24
Scott	Scott Paper	V	TFl-43	50	TFL						
Scott	Scott Paper	V	Fraser	2	TSL						
Scott	Scott Paper	V	Kingcome	5	FL						
Scott	Scott Paper	V	Soo	5	FL						
Scott	Scott Paper	V				30	491	New Westm	28 000mt	74	
			TOT TENURE	62	TENURE PROT	84%			TOT RWE	74	0
Columbia R.	Col R. S&S	N	Kootenay Lk	10	FL						
Columbia R.	Col R. S&S	N	Kootenay Lk	19	TSL						
Columbia R.	Col R. S&S	N	Kootenay Lk	19	TSL						
Columbia R.	Col R. S&S	N				1	238	Nakusp	312 Ksqs	172	
			TOT TENURE	48	TENURE PROT	28%			TOT RWE	172	0
Ardew	Ardew Wd Pr	K	Merritt	36	FL						
Ardew	Ardew Wd Pr	K	Merritt	33	TSL						
Ardew	Ardew Wood Pr	K				18	207	Merritt	31 MMfbm	135	54
			TOT TENURE	69	TENURE PROT	51%			TOT RWE	135	54
Morricetown	Morricetown Bond	PR	Bulkley	14	TSL						
Morricetown	Morricetown Bond	PR	Bulkley	45	TSL						
			TOT TENURE	59	TENURE PROT	--			TOT RWE	0	0
Remco	Remco Cedar Pr	N	Kootenay Lk	6	FL						
Remco	Remco Cedar Pr	N	Kootenay Lk	19	TSL						
			TOT TENURE	25	TENURE PROT	--			TOT RWE	0	0

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC VOL 000 M3	LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
	CIPA Lumber Co	V				38	312	Nanaimo	74 MMfbm	382	149
	Cooper Creek Cedar	N				13	0	Meadow Creek	14 MMfbm	61	24
	Creekside For Prod	V				31	0	Pemberton	10 MMfbm	52	20
	Daken For Prod	V				31	664	Squamish	7 MMfbm	36	14
	Daken For Prod	V				31	664	Squamish	26 Ksqs	14	
	Darfield Bldg Prod	K				11	224	Darfield	7 MMfbm	31	12
	Delta Cedar Prod	V				30	326	Delta	24 MMfbm	124	48
	Dulay Lbr Co	V				30	0	Burnaby	10 MMfbm	52	20
	Fraser Pulp Chips	V				30	538	Surrey	10 MMfbm	52	20
	Giesbrecht Sawmills	V				38	0	Alberni	10 MMfbm	52	20
	Glenn Properties	K				11	66	Barriere	22 MMfbm	96	38
	Goldwood Industries	V				30	537	Richmond	38 MMfbm	196	77
	Hidden Ck Tbr	N				1	0	Salmo	38 MMfbm	166	66
	HP Mills Kelowna	K				22	0	Kelowna	7 MMfbm	31	12
	Irus Logging	N				2	0	Beverdell	7 MMfbm	31	12
	Kamloops West Wood	K				11	0	Kamloops	14 MMfbm	61	24
	Karr Pivu Sawmills	K				11	0	Kamloops	7 MMfbm	31	12
	Lakeside Tbr	K				11	597	Tappen	10 MMfbm	44	17
	Lamford Cedar Prod	V				38	451	Sooke	72 MMfbm	gone	gone gone
	Lindal Cedar Homes	V				30	580	Surrey	29 MMfbm	150	58
	Lytton Lumber	K				15	116	Lytton	38 MMfbm	166	66
	McDonald Ranch & Lbr	N				5	197	Grasmere	7 MMfbm	31	12
	Nagaard Sawmills	V				37	408	Pt Alberni	7 MMfbm	36	14
	North Star Planing	N				9	199	Athalmer	7 MMfbm	31	12
	Paragon Ventures	K				22	665	Grindrod	48 MMfbm	209	84
	Parker Cedar Prod	V				30	421	Surrey	12 MMfbm	62	24
	Pitt Timber	V				30	425	Pt Coquitlam	24 MMfbm	124	48
	Primex For Prod	V				30	283	Delta	77 MMfbm	398	155
	Primex Fibre	V				30	241	Delta	144 Kbdu	374	
	Primex For Prod	V				37	334	Courtenay	48 MMfbm	248	97
	S & O	N				2	0	Rhone	7 MMfbm	31	12
	S & R Sawmills	V				30	454	Pt Kells	163 MMfbm	842	328
	H Seel & Son	N				9	87	Edgewater	10 MMfbm	44	17
	P Soles Lumber	N				9	200	Harrogate	12 MMfbm	52	21
	Stag Timber	V				30	539	Surrey	48 MMfbm	248	97
	West Kettle Wood	N				2	0	Beaverdell	10 MMfbm	44	17
	Westcoast Cellufibre	V				30	409	Vancouver	48 MMfbm	248	97
	Woodland Lumber	PG				234	672	Pr George	17 MMfbm	70	27
			TOT TENURE	0	TENURE PROT		0%		TOT RWE	4915	1777
CMFD	Arrow Lk Cedar Pole	N	Revelstoke	4	TSL						
CMFD	Carney	K	Okanagan	14	TSL						
CMFD	B J Carney & Co	K				11	6	Sicamous	19 K pieces	14	
CMFD	B J Carney & Co	N				1	647	Nakusp	14 K pieces	11	
			TOT TENURE	14	TENURE PROT		57%		TOT RWE	25	

CORP GROUP	OP COMPANY	REG	TSA/TFL	AAC 000 M3	VOL LIC	TSA#	MILL#	MILLTOWN	MILL CAPACITY	LOGS RWE m3	CHIPS RWE m3
Indep. S	S.N. Forsyth	PR	Kispiox	12	TSL						
Indep. S	Hagman & Son	V	Sunshine C	14	TSL						
Indep. S	Hauer Bros	PG	Robson V.	11	TSL						
Indep. S	McMahon Lbr	V	Fraser	19	TSL						
Indep. S	QCI Sawmills	V	Queen Charl	20	TSL						
Indep. S	QCI Sawmills	V				25	0	Masset	10 MMfbm	52	20
Indep. S	Texada Logging	V	Arrowsmith	14	TSL						
Indep. S	Ymir FP	N	Kootenay Lk	24	FL						
Indep. S	Ymir For Prod	N				1	658	Ymir	19 MMfbm	83	33
Indep S	Bear Lbr Co.	N				5	643	Lumberton	7 MMfbm	31	12
Indep S	Canada Hobushin Lbr	V				30	0	Surrey	10 MMfbm	52	20
Indep M	GPL Treatment	V	Mid Coast	33	FL						
Indep M	Hecate Logging	V	Strathcona	78	FL						
Indep M	Abfam	V				25	0	Pt. Clements	24 MMfbm	124	48
Indep M	Dist of Mission	V	TFL-26	41	TFL						
Indep M	Norvik Timber	V	Fraser	65	FL						
Indep M	Abfam Ent.	V	Queen Charl	40	TSL						
Indep M	Ash R.	V	Mid Coast	91	TSL						
Indep M	Coulson FP	V	Arrowsmith	52	FL						
Indep M	Sitkana Timber	V	Queen Char	27	FL						
Indep M	Norvik Timber	V				30	298	Delta	72 MMfbm	314	126
Indep M	Raven Indust	V	Strathcona	15	TSL						
Indep M	Raven Lumber Ltd	V				37	434	Campbell R	77 MMfbm	398	155
Indep M	CRB Logging	V	Soo	27	FL						
Indep M	Zaul-Zap Ind.	PR	Kalum	50	FL						
Indep M	Thomson Ind.	PR	North Coast	31	FL						
Indep M	Stege Logging	PR	Kispiox	64	FL						
Indep M	Stege Logging	PR				12	558	New Hazelton	38 MMfbm	158	61
Indep M	Can. Chopstick	PG	Ft. Nelson	77	FL						
Indep M	Meadow Ck Cedar	N	Kootenay Lk	51	FL						
Indep M	Meadow Ck Cedar	N				13	603	Cooper Ck	10 MMfbm	44	17
Indep M	Lytton Lbr	K	Lillooet	33	FL						
Indep M	Bruce Fitchner	C	Williams Lk	60	TSL						
Indep M	C&C Wood prd	C	Quesnel	30	FL						
Indep M	C&C Wood Prod.	C				26	562	Quesnel	34 MMfbm	141	55
			TOT TENURE	865	TENURE PROT	73%			TOT RWE	1178	414

milmodls

SOLID PRODUCTION COEFFICIENTS - AVERAGE %

REGION	SAWMILLS				Product
	SAWNWOOD	CHIPS	HOGFUEL	TOTAL	solids/nominal
VANCOUVER	42.5%	39.0%	18.5%	100.0%	93.0%
KAMLOOPS - NELSON	39.0%	40.0%	21.0%	100.0%	72.0%
CARIBOO	41.0%	39.0%	20.0%	100.0%	72.0%
PRINCE GEORGE - RUPERT INTERIOR	41.0%	39.0%	20.0%	100.0%	72.0%

	VENEERMILLS				Product
	VENEER	CHIPS	HOG/OTHER	TOTAL	solids/nominal
VANCOUVER	52.0%	27.0%	21.0%	100.0%	100.0%
ALL OTHERS	47.0%	31.0%	22.0%	100.0%	100.0%

SHAKE/SHINGLE MILLS
70:30 RATIO

	SHA/SHI	CHIPS	HOGFUEL	TOTAL
ALL REGIONS (1.81 sq/m3)	45.0%	25.0%	30.0%	100.0%

POLE-YARDS

	POLES	HOG/WASTE	TOTAL
ALL REGIONS (0.75 m3log/pole)	67.0%	33.0%	100.0%

PULPMILLS

ALL REGIONS

5.3-5.6 M3 PER TONNE - CHEMICAL

2.3-2.6 M3 PER TONNE - MECHANICAL

SOURCE: MOF (Valuation Branch)
Statistics Canada
Industrial Inquiries

FOREST RESOURCE MANAGEMENT ALTERNATIVES STUDY

TMT File No.: 2792
TMT Report No.: R9108

Prepared for:

BRITISH COLUMBIA FOREST RESOURCES COMMISSION
Victoria, B.C.

Prepared by:

FORTRENDS CONSULTING
CLAYTON RESOURCES LTD.
ROBINSON CONSULTING & ASSOCIATES LTD.

March 1991

PA:jl R9108.W51-R-12WP5

FORTRENDS Consulting Inc.
A division of T.M. Thomson & Associates Ltd.

FORTRENDS Consulting Inc.

A Division of T.M. Thomson & Associates Ltd.

Head Office
1006 Government Street, Victoria, B.C., Canada V8W 1X7 Tel. (604) 385-4468 Telex 049-7345 FAX (604) 385-1442

March 8, 1991

File: 2792

British Columbia Forest Resources Commission
700 - 747 Fort Street
Victoria, B.C.

Attn.: Mr. Sandy Peel
Chairman

Dear Mr. Peel:

We are pleased to submit the attached report "Forest Resource Management Alternatives Study."

Thank you for the opportunity to work on this project.

If you have any questions or comments, please do not hesitate to call.

Yours truly,

CLAYTON RESOURCES

G.K. Bowden
Principal

FORTRENDS CONSULTING

P.N. Affleck, R.P.F.
Manager

ROBINSON CONSULTING AND ASSOCIATES LTD.

G.C. Robinson
Principal

PNA:jl
Enc.

Victoria Office: 1006 Government St., Victoria, B.C. V8W 1X7 Tel. (604) 385-4468 Telex 049-7345 FAX (604) 385-1442
Vancouver Office: 804 - 535 Thurlow St., Vancouver, B.C. V6E 3L2 Tel. (604) 687-3346 FAX (604) 687-8427
South East Regional Office: 609 Baker St., Nelson, B.C. V1L 4J3 Tel. (604) 352-0122 FAX (604) 352-6063
North East Regional Office: P.O. Box 6428, Fort St. John, B.C. V1J 4H8 Tel. (604) 785-8659 FAX (604) 785-8728

TABLE OF CONTENTS

Page

TITLE PAGE i

LETTER OF TRANSMITTAL ii

TABLE OF CONTENTS iii

EXECUTIVE SUMMARY iv

1.0 INTRODUCTION ..... 1-1 to 1-4

2.0 STUDY APPROACH AND DATABASE ..... 2-1 to 2-11
2.1 Development of the Study Framework 2-1
2.2 The Forest Estate and Forest Values 2-2
2.2.1 Timber Indicators 2-4
2.2.2 Livestock Grazing 2-6
2.2.3 Wildlife 2-8
2.2.4 Fisheries 2-9
2.2.5 Recreation Activities 2-9
2.2.6 Non-Use Values 2-10

3.0 MANAGEMENT OPPORTUNITIES WITHIN THE FOREST ESTATE ..... 3-1 to 3-34
3.1 The Rate of Harvest and Maintenance of the Capital Base 3-2
3.1.1 Annual Harvest Levels and the Capital Base/Inventory 3-2
3.1.2 Potential Annual Harvests From the Forest Estate 3-7
3.2 Direct Financial Return From Timber Harvests 3-14
3.2.1 Harvest or Utilization Standards 3-17
3.2.2 Returns to Silvicultural Expenditure 3-21
3.3 Managing For All Resource Values 3-27
3.4 Choosing a Preferred Management Option 3-30

4.0 ACCOUNTING FRAMEWORK FOR THE FOREST ESTATE . . 4-1 to 4-17
4.1 The Physical Account 4-2
4.2 The Value Account 4-4
4.2.1 Indicator of Sustainability 4-5
4.2.2 Valuation 4-7
4.2.3 Natural Resource Consumption 4-10
4.3 Illustration of the Value Account 4-13
4.3.1 Capital Account 4-14
4.3.2 Income Statement 4-15
4.3.3 Balance Sheet 4-16

5.0 REFERENCES

APPENDICES (under separate cover)

APPENDIX I Definition of Scenarios and Models Used in the Study

APPENDIXII Tabular Summaries of Harvests, Age Class Distribution by Area and Volume, and Cash Flow, for 12 Forest Management Options, as determined by FIBRPLAN-III

APPENDIX III Incorporating Non-Timber Values in Forest Management

APPENDIX IV Schedule for Levelizing Income from a Finite Series of Capital Payments

APPENDIX V Maps

APPENDIX VI Timber Replacement Analyses for Options 11 and 12

EXECUTIVE SUMMARY

In its initial reports, the British Columbia Forest Resources Commission identified several concerns which contribute to public anxiety over the state of British Columbia's forest resources. These include whether present harvest rates are sustainable; whether management practices recognize the full values of both commercial and non-commercial uses of the forest; whether the province is obtaining a fair return from timber harvests; and whether there is a system through which the results of various management practices can be monitored and the effects on resource stocks accounted for.

In response, the Commission wished to explore whether there were different, and better, ways to plan for **forest management** than the traditional approach to **timber management** that is perceived to prevail in British Columbia's forests.

This report has been prepared for the Commission, in an effort to answer that question. The approach has been to build an analytical **framework** which can be used to examine the effects of various forest management practices and decisions. The framework is built around a forest estate model known as FIBRPLAN-III, with input to the framework to account for non-timber values originating independently of the model. To give the framework a real world test, it was applied in a **pilot study** using a 40 000 ha forest in the interior of the Province.

The report is organized to indicate how the framework was used to address the various concerns in forest planning, and how the implications of different management responses can be tested.

With respect to concerns about the sustainability of harvest rates, several findings emerge from the pilot study. First, what can be done in a forest in the short run, which may be several decades, depends on the present endowment of timber. This will be a function of the original forest, past harvests, and such natural events as fires and insect outbreaks. The menu of possibilities will be different, therefore, for each individual "forest" in the province.

Given that the opportunities analyzed relate to a specific forest, the analysis indicates nevertheless that there is a wide range of harvest rates (annual allowable cut, or AAC) which are sustainable indefinitely. These harvest rates vary, depending on the harvesting standards adopted, the harvest methods (clear cut or shelterwood), the level of silvicultural effort, and

the extent to which land is withdrawn from timber harvesting to provide for other forest values (recreation, wildlife).

For what might be characterized as the most common combination of forest management practices, AAC's from 105 000 m^3 to 175 000 m^3 where identified, with the AAC's increasing in response to increased silviculture intensity. With a major emphasis on forest management for wildlife and/recreation, harvests of about 97 000 m^3 were indicated to be sustainable.

In direct response to the concern that the Ministry of Forests is allowing excessive rates of harvest, that was not found to be the case for the forest used in the pilot study. Applying the Ministry of Forests' approach to determining the AAC, the indicated harvest level was some 83 000 m^3, considerably below what the pilot study analyses indicate to be sustainable.

What the analyses clearly demonstrate is that selection of the timber management program for a forest is a matter of choice, and need not be dictated by technical criteria alone. That is, the sustainable harvest level is not a unique value, but is largely determined by the level of management input. While the quantitative findings are specific to the forest estate adopted for this study, experience indicates that the general conclusions derived here would be similar, although not precisely duplicated, in other forests.

The analytical framework also recognized the effects on non-timber values in managing the forest. When management objectives emphasized timber production, the forest adopted for the pilot study supports a reasonably high level of other uses, including livestock grazing, fish and wildlife, and various forms of outdoor recreation. These values were portrayed for a number of management programs that could be characterized as largely "timber driven".

Two specific management programs with timber de-emphasized were also analyzed. One program emphasized wildlife objectives and the other emphasized recreation objectives. Since the level of knowledge regarding these other forest values is less than that relating to timber production, these analyses were of necessity somewhat simplified. They did demonstrate, however, what might be gained from a re-orientation of forest management, and the corresponding consequences for timber harvests.

The framework is not intended to provide a direct answer to the question as to which is the best forest management program. That question is in fact a series of inter-dependant

questions - which is the "best" way to develop opportunities for recreation, the "best" harvest standards, the "best" method of harvesting, the "best" level of silviculture, the "best" way to incorporate livestock grazing and to provide for fish and wildlife, and so forth.

The pilot study sheds some light on the many factors which must be considered when making such decisions by in-depth examination of several basic management criteria. These include harvesting standards, and their implications for both the volume of timber that can be harvested each year and the direct value of the timber harvested. This indicates the significant tradeoffs that are currently embedded in forest policy, and which might be reconsidered (or at least made explicitly) in attempting to implement new approaches to forest management. The implications of alternative levels of silviculture effort are also examined, and again the implicit tradeoffs between the volume of timber being harvested and its value emerge for scrutiny.

It is often the case that the "best" way to provide for any one output from the forest carries with it consequences for the other possible outputs. The framework developed in this study indicates the possible mix of outputs from the forest for a number of feasible management programs. A series of "indicators" in both physical units (numbers of wildlife, months of livestock grazing, m^3 of timber harvested) and monetary measures where appropriate, are portrayed for each management program. These make the tradeoffs between resource uses explicit.

What emerges from the pilot study analyses is that there is no simple answer as to which is the preferred forest management program. A forest is a complex "creature" and how best to manage it may only become evident after considerable testing and examination of the feasible alternatives. The framework that has been developed makes this kind of testing possible, with the intention that a management program that is judged to best serve the public interest can ultimately be selected.

The end result of such a process may well be that no particular user of the forest is completely satisfied, as no one use is developed to its full potential. The overall contribution to the well being of society may be maximized, however, and it is left to those who accept responsibility for choosing a management program to stand accountable for their decisions and the tradeoffs which are made.

Given that a forest management program has been selected which contains specific forest resource targets and management objectives, it is important that a framework is in place to verify whether the targets are being met. The absence of clearly articulated forest management targets in the public forests of British Columbia has created a vacuum, as there is no basis to develop a framework for assessing performance or to establish the credibility of resource management programs. This extends across the management of all resources within the public forests - timber, wildlife, livestock grazing, recreation, and so forth.

The report suggests a relatively simple accounting framework for monitoring forest management performance over time, through a series of annual reports. These would incorporate both physical and monetary measures.

The Physical Account would report on the wildlife populations, the amount of recreation activity in the forest, the amount of timber harvested and the status of regenerating stands, the amount of livestock grazing supported, and so forth. The systematic monitoring reflected in the Physical Account would clearly show deviations from the management targets and the need to re-evaluate management programs.

The monetary, or Value Account, would consist of a modified set of annual financial statements. This study demonstrates how the Account could be developed for a forest estate and illustrates its usefulness using one of the forest management alternatives. The Value Account provides information about resource depletion, the security of the resource base, and the ability to draw income from the forest assets on a sustainable basis.

In conclusion, the analytical framework developed here provides a valuable planning perspective. While this is a positive result, it must also be noted that the forest estate selected provided a relatively uncomplicated challenge. That is, good forest inventory information was readily available, there were no intractable resource conflicts, and the process was devoid of special interests and inter-agency competition that often characterize forest planning in British Columbia. Whereas we feel the framework is sufficiently robust to accommodate these pressures, the logical next step would be to test it at the TSA Steering Committee level as a planning tool.

1.0 INTRODUCTION

A wide range of concerns about forest management in British Columbia has been identified by the British Columbia Forest Resources Commission.[1] To respond to these concerns, it is the Commission's desire to test some of the various hypotheses about the results of alternative forest management policies and practices. The scope of that testing follows from the basic principles identified by the Commission. Paramount among these is a "draft vision statement"[2]

> **The forest resources of British Columbia must provide for the social, spiritual, environmental and economic well-being of British Columbians. They must be managed in such a way that these values are maintained for future generations.**

Subsidiary to this, the discussion of economics sets out two guiding principles[3]:

- Forest capital base should be sustained for future generations;
- Return on all forest values should be optimized.

The Commission has clearly stated its view of the economic significance of the forest industry in the provincial economy - **"There is no doubt that our forest resources are the major source of economic wealth and development in British Columbia."**[4]

Forest management is a complex subject, and given the economic significance of the forest resources, the Commission recognizes the need to thoroughly test the implications of alternatives for forest management. Accordingly this study was commissioned to develop a framework that would allow an evaluation of the impacts of various forest management options and test that framework in a pilot study.

---

1. British Columbia Forest Resources Commission. 1990. Forest Resources Commission Options Paper. Victoria, B.C.
2. Options Paper, p. 6.
3. Options Paper, p. 43. The discussion of Forest Resource Management, pp. 15-34, also states guiding principles as **"manage for all forest values to provide optimal use"**, and **"management practices must ensure economic and environmental sustainability"** (see p. 15).
4. British Columbia Forest Resources Commission. 1990. Options Paper Summary, p. 10.

The framework that has been proposed has two main elements - a modelling component to display the various options for decision making, and an accounting component to track forest management performance. The modelling component is built around a forest estate planning model, FIBRPLAN-III, supplemented with independent estimates of non-timber resource values. To support decisions and facilitate choices between forest management programs, value indicators are developed for the various outputs from use of the forest resources. The accounting framework component is developed to measure forest management performance, with reference to key indicators that reflect production targets and other concerns.

A study of this nature cannot address all of the concerns which have been raised, and the current study is restricted to two related goals. The first is to establish a framework for evaluation of management options. The second, by way of "proving up" that framework, is to provide an initial evaluation of some policy or management options in a pilot study. If the initial application of the framework provides a clear indication of the effectiveness of various policies or management practices, then its application can be extended to deal with other concerns identified by the Commission.

The concerns which are dealt with in the present study are expressed at various points in the Commission's Options Paper, and include whether:

- Present harvest rates will preclude future economic options;
- Management practices recognize the full values of commercial and non-commercial uses of the forests;
- The province is receiving a fair return from timber harvests;
- A system is in place to monitor the results of various management practices and account for depletion of, or additions to, resource stocks.

The intent of the pilot study is to apply the framework to examine a range of resource management options for a particular land base, given it's fundamental bio-physical capability to contribute to the "**... social, spiritual, environmental and economic well-being of British Columbians.**" The examination is not to be constrained by existing policies or institutional arrangements for the management of forest land and related resources.

The pilot study is based on an actual tract of forest land in the province, which is referred to in this report as the "**forest estate**". This provides a realistic data base for fundamental

productivity regarding timber, range, wildlife, fish, recreation and other services from the forest land. The data reflect the "real world" level of resource information that is available for decision making. This ensures that the pilot study analysis reflects achievable levels of management. At the same time, because the pilot study is tied to a particular forest tract (in the interior of the province), it is necessary to warn that there are limits on the degree to which the findings can be generalized to other forest lands in the province.

The current study is not designed to critique existing forest management policies, but to portray the effects of alternative policies on the selected forest estate. It does not provide an index which indicates the "best" management regime. It is a supplement to, rather than a substitute for, informed decision making. By portraying the different outcomes of alternatives the implications of management options are made explicit, and those who are responsible for choosing among alternatives will be aware of the consequences of their decisions.

Although we have used data specific to a particular land base, it is necessary to warn against placing too close an interpretation on the results. The Commission has previously noted that inventory data differ significantly in quality across resources, and this leads to situations where there is inadequate and imperfect information on which to base management decisions.[5] This certainly applies to the data available for the pilot study, although they are adequate to support basic management decisions. It has been necessary to make some fairly crude assumptions about resource capabilities in several areas, and the estimates regarding the costs and returns from management of the resources are as crude as the assumptions on which they are based.

We believe that the data, assumptions and forecasts are appropriate to a "pilot study", given that a major goal is to develop a clear understanding of the effects of implementing particular policies or management practices. But the estimates are not precise and the projected outcomes should not be considered "bankable". One would prefer not to choose a specific management program for a tract of forest land solely on the basis of the pilot study results. Rather the pilot study could be used to narrow the options being considered,

5. In the Interim Report of the British Columbia Forest Resources Commission, in July 1990, the Commission reported to the government its concern "...that good inventory information pertaining to the full range of forest values and to the capacity of the forest land base to support those values is seriously inadequate." and, "that decision makers and the public have very inadequate and imperfect information on which to base decisions or debate."

and expose areas requiring more in-depth examination before a final management program was formulated.

2.0 STUDY APPROACH AND DATABASE

This section of the report explains the approach that has been taken in developing the study framework, describes the "forest estate" which is used in the pilot study, and explains the different values that could be realized through forest management.

2.1 DEVELOPMENT OF THE STUDY FRAMEWORK

The study has been approached as though the objective was to develop a management plan for the forest estate. The plan would not be confined to management of marketable commodities, but would take a broad view of the possible outputs from the forest estate. The essence of the plan is to address **forest** management, in the broad sense of all values yielded by a forest, as opposed to the narrower range of values that might be addressed by **timber** management.

A primary goal of the framework is to demonstrate the broad range of management options which can be implemented within the forest estate. There is no mechanism through which these options can be articulated at present, as management of the resources found within the estate is carried out by various government agencies within a framework of fragmented responsibilities. Given these different management responsibilities and different "referent groups" to which agency employees feel accountable, each agency is in a position to make demands on the resources but none has an incentive to temper those demands with an overriding responsibility to the "public good".

The consequences of this are "... endless argument about land base allocation and resource use tradeoffs ..."[1] The cause has been clearly recognized by the Ministry of Forests:

> At present, government policy does not specify integrated resource development objectives and priorities. Consequently, the tendency of resource agencies is to manage their resource to the maximum capability of the land. Government must recognize that not all resource objectives can be met.[2]

1. Ministry of Forests. 1984. 1984 Forest and Range Resource Analysis. Victoria, B.C.

2. Ministry of Forests. 1980. Forest and Range Resource Analysis Technical Report. Victoria, B.C.

In defining management options for the forest estate we have not confined ourselves to options that are necessarily compatible with existing policies and regulatory regimes. We have tried to define options that are feasible from the perspective of a person or body held responsible (and accountable) for managing all of the resources of the forest estate, which would require cutting across established lines of authority.

In order to meet a responsibility to manage for all resources of the forest estate, a manager would have to be fully cognizant of the interrelations between uses of those resources. This is what the framework tries to indicate in the options that are developed - if there is a desire to attain a given level of output from one resource, it asks "Can that be done?", and "What are the consequences for other resources and their output?" By indicating the possible mix of outputs for each management alternative, the framework makes the tradeoffs that may be required between resource uses explicit. Faced with these projections, a management program that is judged to best serve the overall public interest (although it may not maximize the output from any single resource) can be selected for implementation.

A significant departure from present management practices that is incorporated in the pilot study is the way in which timber management is planned. The pilot study deviates from the present practices of the Ministry of Forests with respect to a number of key management practices, including determination of the allowable harvest levels (annual allowable cuts, or AAC), harvest specifications, and silviculture practices. In doing this the pilot study introduces more flexibility than is currently possible under the relatively constrained planning procedures used by the Ministry. The options in the pilot study are developed using the FIBRPLAN-III forest estate planning model, which provides for considerable flexibility in planning the harvests and inputs to forest management.[3] Thus the analyses of timber management do not reflect the way in which decisions would be made with current approaches, but rather indicate choices that are available under a more flexible approach.

2.2 THE FOREST ESTATE AND FOREST VALUES

The forest estate adopted for the pilot study lies in the central interior of the province and encompasses some 40 000 ha of Crown land. It represents a fairly typical forest

3. For a review of the various aspects of the models that are available see: Ministry of Forests. 1990. Forest Estate Models, Five Models for Planning Silviculture Programs: A Review and Evaluation.

management opportunity, with growing sites that range from poor to good, and existing stands of spruce, lodgepole pine, Douglas fir, and balsam that also range from poor to good. As in many forests where commercial timber harvests have been taken over the past forty years or so, the age distribution of the timber stands is skewed toward overmature old growth.

The forage resources on the estate provide summer grazing opportunities for cattle, under permit. The land and water courses within the estate provide habitat for a typical range of fish and wildlife species in the interior of the province. The estate is open to the public for recreation purposes, and activities include fishing, hiking and camping, hunting, snow sports and vehicle touring. This resource endowment defines, and limits, the resource management opportunities addressed in this pilot study.

The forest estate offers the challenge of managing a broad spectrum of resources. In principle one would seek an "optimal" combination of uses such that the highest net return would be attained. To do this requires accepted ways to value the various outputs, and knowledge about the interrelationships in their joint production. Since management often must proceed with imperfect knowledge on both accounts, the study framework addresses this objective by defining a number of "indicators" which serve as measures of the output of each resource use. These indicators, which are discussed for each of the estate resources, do not all measure "value" in the same terms. Hence they cannot be distilled into one number that indicates the overall merit of a management option, nor can they be compared across alternative options to indicate which is "the best". What they do, however, is make the tradeoffs between resource uses, and between options, clear and provide a reference point for choosing between those options.

A broad perspective has been taken in developing the indicators. Were the forest estate under private ownership we would expect the focus to be on marketed commodities, such as timber and grazing, and on the direct net financial returns from those uses. But a broader public perspective on use of the forest estate would recognize that such outputs enter into other production processes beyond the boundaries of the forest, and would take account of those activities. The public perspective would place weight on employment opportunities, created both directly on the estate and in related activities elsewhere in the province. In addition the various payments to governments, seen simply as a cost from the private perspective, would also be seen as relevant "outputs" from use of estate resources. So while the indicators will include the economic measures that a private owner would take into

account in developing a management plan, they are extended to include other, broader, measures that are of concern from a public perspective.

The other challenge to forest management is how to incorporate non-marketed commodities - various forms of recreation, as well as non-use or amenity values - in developing a management program. In the absence of direct, market derived, information on the value of such resource uses, other indicators are used to denote the magnitude of the output, and its relationship to the production of marketed commodities.

The various "indicators" which are developed in the framework study are described for the major resource uses in turn. In the interest of brevity, a full exploration of the issues involved in incorporating non-timber values in forest management has been relegated to Appendix 3.

2.2.1 TIMBER INDICATORS

Timber production on the forest estate is relatively well understood, and using FIBRPLAN-III can be modelled for the response to different management priorities and levels of input. The measures of timber production that are used as decision indicators begin with the physical flow of output, the **allowable annual cut, or AAC, in cubic metres (m^3)**. The **average number of hectares harvested** each year is also indicated.

An important economic indicator that has been developed is referred to as the **average net value generated** from timber harvests. This is a measure of the direct cash flow to the forest estate, and is expressed both as an average annual total, and on the basis of dollars per m^3 harvested. It is derived by deducting from the estimated value of the timber harvested all of the harvesting, silviculture and management costs. The value of the timber produced has been based on estimates of log values, as of mid-1990, which were derived from end product values less milling costs. Harvesting, silviculture and management costs are based on experience in forests similar to the forest estate at mid-1990.

The levels of silviculture effort and timber management intensity differ quite markedly between the options analyzed. This affects both the level of harvests and the net value realized. Silviculture expenditures should properly be analyzed as investments, with the outlays incurred in the present repaid with increased harvests, or more valuable harvests, in

the future. That kind of analysis is more complex than can be addressed in the pilot study, however, and silviculture costs are treated as current management expenses. The measure of net value generated is therefore very much a cash flow measure.

The estimate of net value generated is the best indicator of the economic efficiency of a timber management option. It indicates the wealth which is created by timber harvests, by measuring the extent to which the timber produced exceeds the cost of the inputs required in production. This is the indicator on which a private landowner would be expected to place most emphasis in selecting a timber management program.[4]

From a public perspective, employment opportunities and payments to government are also looked to as important "goods and services" attained through use of resources, and indicators have been developed for both. For employment, estimates are provided for **direct employment** in timber harvesting and processing (work on the forest estate in silviculture and harvesting as well as in processing the logs and by-products in sawmills and pulpmills). The direct employment indicator is based on 0.97 person-years of employment per 1000 m^3 of timber harvested. **Indirect employment** opportunities in businesses supplying the forest industry are also estimated, on the same basis of 0.97 person-years per 1000 m^3 harvested, the implicit ratio of direct to indirect employment being 1:1.[5]

Payments accruing directly to governments are also developed as indicators. To begin, a significant portion of the net value generated is appropriated by the province through a stumpage levy. **Stumpage payments** are estimated as a key indicator of the direct returns

4. The figures presented in this study are annual averages, which conceal a considerable variation in net value generated from year to year. A private owner would be expected to take account of this variation and select the timber management option for which the discounted present worth of net value was maximized. For the present study, however, the Commission indicated that it would be adequate to express net value as a simple average over the period of analysis.

5. **Induced employment**, resulting from the need to supply goods and services to those directly and indirectly employed and their dependents, is frequently estimated as well. Some studies suggest that induced employment is in the order of 1 person year for each person year in direct and indirect employment. See: Dobie, J. 1988. "Some Economic Aggregates for Canadian Forest Industries", Forestry Chronicle, August. "Employment multipliers for Canadian forest industries average approximately 2.2 for direct plus indirect, and 4.3 when induced is included."

   Because this induced employment is a direct function of the direct and indirect employment, additional estimates are not developed in the pilot study. If those deliberating on the merits of the alternatives wished to include such considerations it would be a simple matter of making the estimates, based on the direct and indirect employment.

to government. The estimates are based on actual average stumpage collected in July of 1990, by species, in the Forest District in which the estate is located. Stumpage averages some $8.50 per m^3 over the management alternatives, varying with the species composition of the harvest.

Annual wages and salaries earned by those in direct employment opportunities are estimated as a basis for determining **income taxes paid on labour income**, to British Columbia and to Canada. The estimate used is $51,800 per direct employment opportunity, being the average compensation plus benefits paid to forest sector employees, as reported for 1989.[6] **Taxes paid on corporate profits** are also estimated and included in the estimates of provincial and federal tax receipts. While tax payments could be traced further as incomes are spent and respent, the estimates of initial payments serve adequately as indicators for the purpose of comparing different management options.

A final indicator that has been developed is referred to as the **bid price** for the right to manage the timber on the forest estate. This is calculated as the present worth (computed with a 5 percent discount rate, over a 50 year period) of the annual amounts that remain after the estimated stumpage is deducted from the net value available. This is intended to reflect what might be offered in the event that the timber rights on the forest estate were put up for bids.[7]

2.2.2 LIVESTOCK GRAZING

The forage resources on the forest estate could be intensively managed for livestock grazing - both in the open meadows and grasslands, and in forested areas in the aftermath of logging. But in managing for livestock grazing several important interrelationships must be dealt with. One is the use of forage by domestic stock and by wildlife. This relationship is generally thought to vary from complementary at low intensity of use to competitive at high intensity of use - and has proven a difficult challenge for range managers in British Columbia. A

6. Price Waterhouse. 1989. The Forest Industry in British Columbia. Vancouver B.C.

7. Note that the stumpage calculation used for the pilot study is relatively unsophisticated and does not vary across management options in the way that might be expected in practice. To the extent that a more sophisticated means of determining stumpage was employed, the differentials in the bid prices would be narrowed.

second is the interaction between forest seedlings, grass and cattle during regeneration following logging. These relationships, which are discussed in more depth in **Appendix III**, are the subject of ongoing research[8].

In addition to these uncertainties about the relations between grazing and other uses of the forest estate, the economic returns from range improvement expenditures are not very robust, as is also discussed in **Appendix III**.[9]

With all of these uncertainties we have not felt capable, at a pilot study level of effort, of making realistic projections regarding the extent of range improvement that could be undertaken, the costs, and the results in terms of livestock use and effects on other resource uses. Accordingly, a conservative approach has been taken to livestock grazing. It is assumed that present levels of use would continue to be supported, across all forest management options. If a comprehensive management program for the entire forest were selected, there could be provisions for exploring carefully the opportunities for increased livestock grazing, through site-specific management initiatives.

Because grazing is a relatively minor activity on the forest estate, we have developed only a few indicators for use in the pilot study. The primary measure of livestock grazing used is the physical measure of use, **animal unit months (AUM's)**. Additional indicators include an estimate of the **net value** of the forage, which is estimated at **$6 per AUM**. **Grazing fees** paid to the province are also estimated, based on the 1990 fee level of $1.55 per AUM.

The contribution to incomes of those involved in livestock production is essentially included in the estimate of the net value of the forage, and as incomes in livestock production are very difficult to estimate, a separate indicator is not developed. Estimates are developed for the person-years of **direct employment** associated with (but not wholly supported by) the livestock being grazed at the ratio of 1 man-year per 1,280 AUM's.

---

8. Ministry of Forests. 1989. Range Program Review, Final Report of the Review Task Force.

9. See also: Barichello, R. 1978. An Economic and Distributive Evaluation of Community Pasture Programs, Department of Agricultural Economics, University of British Columbia; Sterling Wood & Associates. 1982. Cost-Benefit Comparative Analysis of Grazing and Forestry Proposals on the McMurdo Benches, prepared for the Invermere TSA Forestry Association; Workman, J.P. 1986. Range Economics, MacMillan Publishing Company, New York.

2.2.3 WILDLIFE

The forest estate supports a typical range of wildlife for the interior of the province, with deer and moose being of principal interest as game species. Some species are resident within the forest estate on a year-round basis, while others (migratory waterfowl, many bird species, and to some extent deer and moose) must go outside the estate to find seasonal habitat requirements, particularly in winter. Management for wildlife must recognize, therefore, that the habitat within the estate itself may not be the determining factor in species abundance.

A basic indicator for wildlife is the **population estimate**, for the key resident species of deer and moose. This is expressed as the over-wintering population that the estate is expected to support under each of the management options[10].

Direct use of wildlife within the estate consists primarily of **recreation** - by hunters, and by others engaged in nature study, and viewing.[11] The amount of **recreation** supported by the estate's wildlife populations is the other major indicator that is used. Since the principles in developing the recreation indicator for wildlife, fisheries, and other recreation opportunities are the same, they are discussed jointly below, in Section 2.2.5.

The pilot study does not consider the option of "privatizing" or commercial provision of wildlife-based recreation opportunities. These have been a significant source of income on private holdings elsewhere[12], and it is conceivable that a similar approach could be taken to management of wildlife in British Columbia. In principle, this may be a straightforward mechanism for emphasizing wildlife management opportunities for the forest estate. But implementation would require a significant attitude shift on the part of many British Columbians, and appropriate enabling legislation.

---

10. Estimates for migratory waterfowl, which use selected wetlands in the estate on a seasonal basis, have not been developed for the pilot study; nor have estimates for grouse, which are important upland game birds. Indicators could be developed, but would require a better inventory of the forest estate's resources than is presently available.

11. Trapping of furbearing species is very limited and is ignored in the pilot study.

12. This has been traditional on many European forest estates. In the United States such practices have been prominent for many decades in the Edwards Plateau area of Texas. In the western mountain States the sale of controlled hunting opportunities for deer and elk, on large private land holdings and Indian Reserves, has become increasingly common within the past 10 to 15 years.

2.2.4 FISHERIES

The issues with regard to fisheries are conceptually similar to those for wildlife. It is not customary for fisheries managers to prepare population estimates for individual waterbodies, and thus the primary indicator for fisheries is an estimate of the amount of **recreation, as user days**, supported by the estate's waterbodies. Further discussion of how recreation is treated in the pilot study analysis follows in Section 2.2.5.

As with wildlife, the pilot study does not consider the option of commercializing the management and use of sport fish stocks on the forest estate. This has been done elsewhere in British Columbia on private lakes, with management aimed at producing a high quality fishing experience in return for an access fee. In the long run this could be seriously considered as a management alternative for the forest estate, but it would require a significant change in public sentiment.

2.2.5 RECREATION ACTIVITIES

The forest estate will be used for recreation activities other than hunting and fishing - the opportunities include vehicle touring and general sightseeing and wildlife observation, hiking and camping, cross country skiing, snowmobiling, firewood gathering, and so forth.

The issues associated with how to value such recreation activity, which is essentially non-marketed in British Columbia, are discussed in **Appendix III**. The direct value of the recreation is difficult to determine, as government policy has treated most opportunities on Crown land as open access common property, for which no fees (or at best nominal fees for hunting and fishing) are levied. Methods have been developed to assign monetary values to such non-priced recreation, but they are of questionable reliability.

Those types of monetary estimates of the direct value of outdoor recreation opportunities are not developed as indicators for the pilot study. The analysis simply estimates the **number of days of different types of recreation** that are likely to be realized under each of the management options. Comparison of the recreation opportunities across the various options allows the forest manager to focus on the tradeoffs between resource uses and outputs. Thus if it is known that as a result of spending on direct management for recreation, and curtailment of other activities with consequent impacts on their output, recreation

opportunities can be increased by a certain amount, the forest manager can turn the question regarding recreation value from "What is it worth?" to "Is it worth it?", and choices between alternatives can be made on that basis.

In the present context it is felt that estimates of monetary value of the non-priced recreation opportunities are more likely to introduce confusion into use of the framework rather than improve the information that is conveyed by using recreation days as an indicator. Such estimates could easily be introduced, if there was seen to be merit in doing so.

A further indicator that is developed is **employment supported by recreationists' spending**, as an index to the economic activity that is derivative from the recreation opportunities provided. Based on previous studies undertaken for the Commission, a ratio of 2.3 man-years employment per 10,000 recreation-days was used here.

2.2.6 NON-USE VALUES

It is recognized that a forest will generate values that do not depend on direct "use" of its resources. For instance, some persons place a value on knowing that areas are not disturbed by man, but left to the forces of nature. These "preservation" values, discussed at more length in **Appendix III**, are often associated with particular geological, biological features or resources that are rare or becoming relatively scarce.

The forest estate adopted for the pilot study contains several areas with attractive visual features which are protected in a management option that places a heavy emphasis on recreation. But we did not identify attributes or resources within the estate of sufficient distinction to suggest that a substantial value would be assigned to fully preserving them and withdrawing them from all extractive uses. Thus there is no management option which would see the entire estate set aside for preservation purposes.

As an indicator of the extent of the estate that is "preserved", however, it would be possible, using map output from FIBRPLAN-III, to assess the area of the forest that is not harvested under each management option. This area could be taken as an indicator of contribution to preservation values. FIBRPLAN-III is capable of generating a series of maps that could be used to further define the "preserved" area of the forest estate for assistance in selection of a management option.

Another concern not directly related to use of resources is the maintenance of bio-diversity. As discussed in **Appendix III**, the concerns raised around this concept range from the pitfalls of monoculture cropping to placing species at risk of extinction.

Concerns about monoculture practices in commercial forestry do not appear relevant to the forest estate within the pilot study, given the variety of species chosen for replanting on specific sites after harvesting. And the diversity of plant and animal species found within the estate is not expected to be affected by continuing with the resource extractive practices (timber harvesting, grazing, hunting, trapping, fishing) which the estate has supported in the past.

Future management could well be more attentive to such issues, however, and inventory the flora and fauna of the estate to identify rare or uncommon resources, and make specific provision for protection of any found to be significant. Explicit provision for this is not made in the management options, however, as it is beyond the level of detail that can be meaningfully dealt with in a pilot study. Attention to this issue could in any event be incorporated as a common element in all of the management options.

3.0 MANAGEMENT OPPORTUNITIES WITHIN THE FOREST ESTATE

There is a broad range of forest management opportunities that could be pursued within the forest estate. To narrow the focus of the pilot study only 12 separate management options are analyzed. These options have been selected to reflect realistic alternatives with present levels of resource management knowledge, and to provide insights into some of the major concerns identified by the Commission. To repeat from the Introduction, these concerns are:

- **Whether present harvest rates will preclude future economic options.** To this we have linked the guiding principle stated by the Commission - the forest capital base should be sustained for future generations;
- **Whether the province is receiving a fair return from timber harvests;**
- **Whether management practices recognize the full values of commercial and non-commercial uses of the forests.** To this we link the second guiding principle stated by the Commission - **the return on all forest values should be optimized.**

The analysis that has been conducted attempts to show how each of these concerns can be addressed in a way that allows responsible management decisions to be made. Each of the options analyzed deals with a harvest level that can be maintained indefinitely, and the implications for the "forest capital base" are demonstrated. Several of the options vary management criteria which have a direct bearing on the ability of timber harvests to yield a "fair return". For each option we attempt to incorporate both commercial and non-commercial uses of the forest.

There is no attempt to provide an "answer" for each concern, however. As will be seen, in most cases there is no single best answer but rather a number of rational choices, each with varying consequences. Should the framework developed in this pilot study provide a useful management tool, then it could be used to assess the implications of a much wider array of alternatives, in support of forest management planning decisions.

3.1 THE RATE OF HARVEST AND MAINTENANCE OF THE CAPITAL BASE

The Commission has received widespread expressions of concern that present harvest levels are too high, that they are not sustainable indefinitely, and by inference that the forest capital base is being depleted. The FIBRPLAN-III model used in this pilot study is capable of showing how alternative harvest levels can be managed over time and the composition and nature of the forest stands associated with those harvest levels.

The relationships between annual harvest levels and the carried inventory of growing stock are complex, so we preface this part of the analysis with a general discussion of them. That is followed by the presentation and discussion of the results of a number of analyses.

3.1.1 ANNUAL HARVEST LEVELS AND THE CAPITAL BASE/INVENTORY

Decisions about the level of forest harvests (the allowable annual cut or AAC) are based in large part on estimates of what the forests that will replace the stands of old growth timber can sustain on an indefinite basis. Harvest levels for those future crops are based on growing trees to the age at which the average annual growth of wood fibre will be maximized. Projections are made about the level of future harvests that can be sustained on that basis, and this determines the maximum level at which harvests can be taken in the long run.

The pattern in which regrowth is expected to yield timber available to harvest is also examined. It is frequently the case that timber available (old enough) to harvest declines significantly as the transition from old growth to successive crops is made. During the low point of this "drawdown" of forest inventory (which may last a decade or more, and is frequently not expected to occur for several decades), annual harvests may have to be constrained considerably below the level that could eventually be supported by successive forest crops.

The approach that is generally used in setting present day harvests puts considerable weight on avoiding future declines (or limiting them within strict parameters. Thus the low point in the forest inventory during the transition from old growth to successive crops may reverberate back to influence present harvest levels. As harvesting progresses the inventory

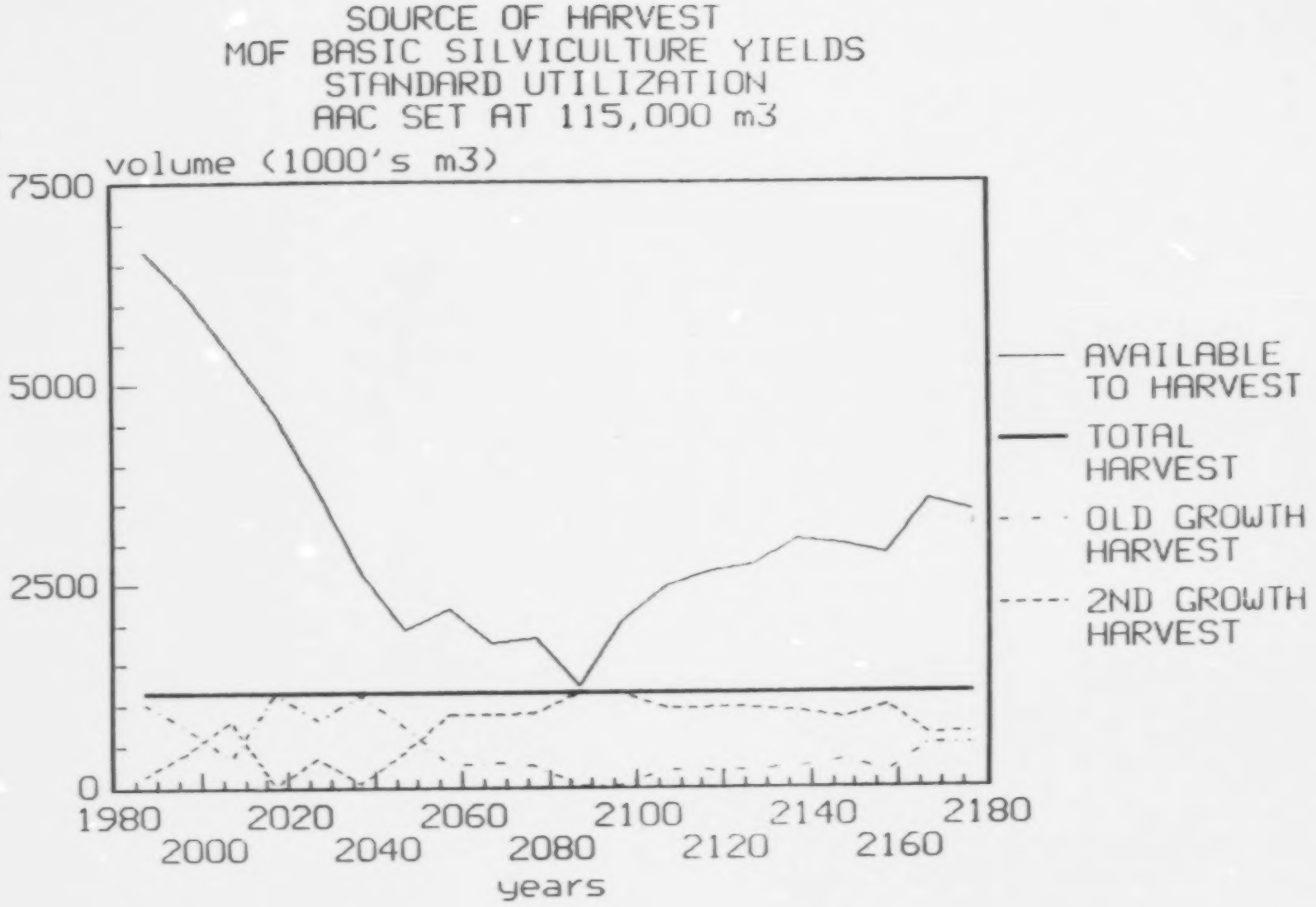

SOURCE OF HARVEST
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 115,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

FIGURE 3.1

of standing timber changes, and as will be discussed below it generally does not return to the initial levels of the old growth forests.

This process can be illustrated with reference to **Figure 3.1**, opposite, from one of the pilot study analyses. By iteration, a rate of harvest has been selected that can be sustained through the transition point which occurs some 100 years into the forest management cycle. This determines the very slow rate at which the initial inventory is harvested. And because the cycle of inventory build up and draw down will tend to repeat (although with diminishing amplitude, and beyond the 200-year planning horizon) harvests are held constant at the initial level for the life of the forest.

Concerns that are expressed about the rate of harvest are generally focussed on the issue of sustainability, whereas the focus of concerns about the capital base is not as clear. To indicate how these concerns can be addressed through the system of setting harvest levels, we discuss harvest rate determination and the implications for the forest inventory over time.

(a) Harvest Rate Determination

The criterion most frequently advocated for setting harvest age, and which in turn determines harvest levels, is maximum sustained yield. This requires harvesting a tree (or stand of trees) at the age where the average annual growth (the mean annual increment, or MAI) is maximized. As can be seen from **Figure 3.2**, following, which demonstrates the typical relationship between volume of wood fibre in a tree (or stand of trees) and age, this would be at the point T1, at which **average annual growth** is maximized. It is important to note that this is reached before the point, T2, at which the **total volume** reaches its maximum. This is a function of the fact that trees grow at a declining rate as they mature. By taking harvests when trees are at age T1, the **volume of timber produced over repeated harvests is maximized.** The result is that forests managed to maximize the **production** of fibre over time, may not attain maximum volumes of standing timber, or **inventory.**

The maximum sustained yield criterion for determining harvest age is not universally supported, however, as it does not incorporate any financial considerations. The optimal financial harvest age will occur when the value of an additional year's growth is just equal

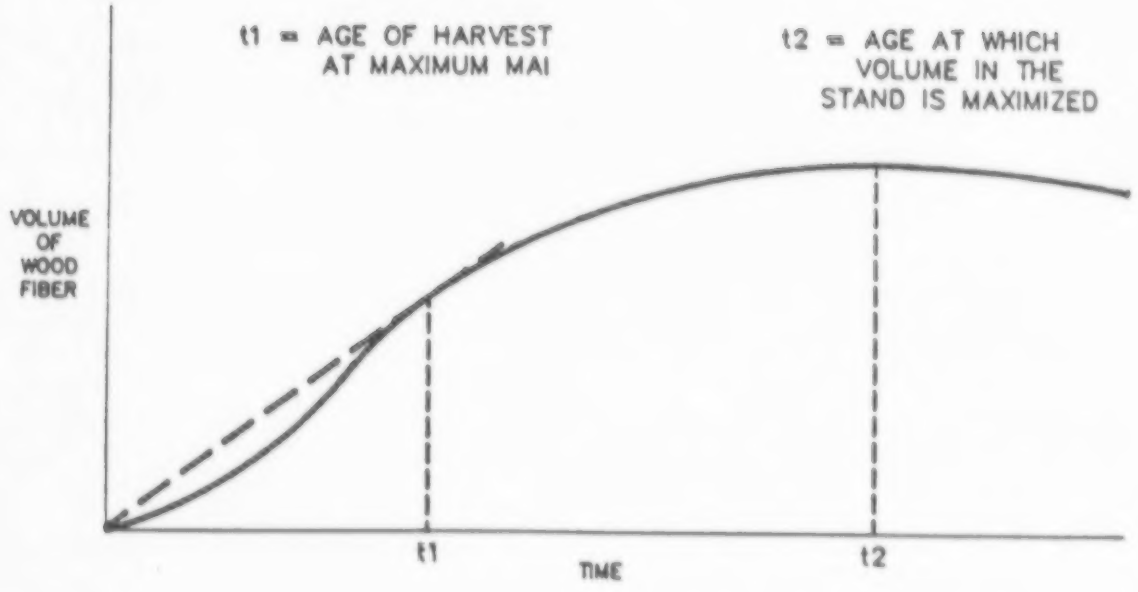

t1 = AGE OF HARVEST
AT MAXIMUM MAI
t2 = AGE AT WHICH
VOLUME IN THE
STAND IS MAXIMIZED
VOLUME
OF
WOOD
FIBER
t1
TIME
t2

FIGURE 3.2

to the implicit cost of postponing the net income from harvest for a year[1]. When growth slows to the point where the annual addition to net value is just equal to the interest rate, it is time to realize the value from the stand and re-establish a new crop on the site. Continuing to grow the trees beyond this age involves a financial loss because the rate of increase in the net value of the stand is less than what could be realized by taking the harvest and investing the net returns elsewhere at the interest rate.

Financial criteria for determining the age of harvest generally lead to harvests being taken earlier than under the maximum sustained yield criterion. In practical terms, while the harvest age determined for coastal Douglas-fir on the basis of maximum sustained yield may be in the order of 80 years, financial criteria sometimes suggest that it should be 30 to 50 years.[2]

Thus there are two criterion that one might expect a prudent forest manager to apply in deciding when to harvest, one aimed at maximizing volumes harvested over time, the other at maximizing financial return or income realized. Whatever the basis for the decision, once taken it also determines the volumes that will be harvested or the harvest level, for the forest. What is important is that either of these criterion would lead to forests with volumes of standing timber, or inventory, far below what would be attained if the trees were grown to advanced ages before harvesting.

(b) Forest Management and the Timber Inventory

In many areas of British Columbia the inventories of old growth timber tend to be high, in terms of gross volume per unit area, because, subject to attack by insects and fires, growth has not been interrupted over long periods of time. Following a typical growth pattern, as in **Figure 3.2**, the trees in these stands continue to add volume, although at a decreasing rate,

1. Gaffney, M. 1957. "Concepts of Financial Maturity of Timber and Other Assets," Agricultural Economics Information, series 62, Raleigh, North Carolina State College.

2. W.F. Hyde. 1980. Timber Supply, Land Allocation and Economic Efficiency, Resources for the Future Inc. Hyde suggests that for coastal Douglas fir in the Pacific Northwest of the United States the optimal rotation age is in the range of thirty to fifty years, depending on land quality, stocking density, regeneration costs and the opportunity cost of capital. It is also reported that harvests of Douglas fir on private forest land in British Columbia are commonly taken at ages between 50 and 80 years, following financial criteria.

for many years[3]. Although tree growth declines with age, the time spans over which growth continues may be very long, and depending on the species, and the result may be very high volumes in some old growth stands.

As the old growth forests in British Columbia are harvested and the province's forests come to be more and more composed of managed stands, harvests will be taken so as to maximize the long run sustained yield (maximum MAI)[4]. That being so, trees will not grow to the ages that were attained in old growth stands, and the volume of growing stock, or forest inventory, will not be as high as that present initially in the original old growth forests.

What might be considered a fairly representative pattern of harvests and forest inventory has already been presented in **Figure 3.1**. This shows inventory, defined as timber available for harvest, and harvests, over a 200-year cycle. It can be seen that the initial inventory, largely old growth, consists of some 6.5 million m^3 of standing timber. Harvests are taken at a level of 115 000 m^3 per year, and as they progress the inventory is gradually drawn down to a low point of only some 1.25 million m^3 in the decade 2080 to 2090. At this point there is little old growth timber remaining to be harvested, and the regrowing second crops begin to reach harvest age and enter the inventory as available to harvest. As the inventory increases with growth it eventually rebuilds to approximately 3.5 million m^3 in about the year 2170.

Under this management option the forest estate, while supporting a constant annual harvest of 115 000 m^3, has its inventory of timber available to harvest drawn down from 6.5 million m^3 to 1.25 million m^3, and rebuilt to 3.5 million m^3, during a 200-year period. The low point in the inventory of timber available to harvest, as the transition from old

---

3. At varying ages the primary species in British Columbia become "over mature" and begin to die, the result being that some stands, while having a very large **gross** volume, include high proportions of decadent trees and yield relatively low **net** volumes of merchantable wood. Removing some of these stands, so that the good growing sites they occupy can be stocked with vigorous second growth timber, provides an important opportunity to maintain or enhance harvest levels in many areas of British Columbia.

4. It is unlikely that financial criteria will be used to set harvest ages. Maximizing the MAI has an overriding appeal for policy because of technical clarity, relative ease and precision of application, and consistency with traditional forestry principles. It is widely held to be the logical goal for harvest management, and provides some assurance that the forest resources will be conserved in perpetuity. Financial criteria may lead to greater net income being realized from the forests, but are generally left for application by owners of private forest land who are not concerned with broader macro-economic goals. (see Lewis, H.V. 1976. "Objectives of Public Forest Policy in British Columbia: Some Economic Observations", in McKillop and Mead, eds., Timber Policy Issues in British Columbia, University of British Columbia Press.

growth to second growth is made in the decade 2080 to 2090, is some 1.25 million m^3. This will support annual harvests of only 115 000 m^3 per year during this decade. As discussed above, to avoid a decline in harvest during this decade, the annual harvests for all periods prior to this time are constrained to the same level of 115 000 m^3.

(c) Maintaining the Capital Base?

Faced with fluctuations in the inventory of timber available for harvest of this nature, it is perhaps not surprising that concerns have been raised as to whether the capital base of British Columbia's forests is being maintained. The concept of maintaining the capital base is subject to a wide range of interpretations, however[5]. These could range from managing with the primary goal of maintaining a constant volume of timber in the forest inventory, at one extreme, to managing to maximize the annual harvests realized over time, at the other. While some might expect the implications for the forest inventory to be the same under either of these regimes, they almost certainly would not be.

As can be seen from the example in **Figure 3.1**, the basic decision driving timber management is the rate at which to harvest. This is based not on what is present in the inventory of old growth, but on what can be supported by successive crops. When the constraint that harvests should be non-declining[6] is added, the choices open to a forest manager frequently become very limited. The level of inventory of trees available to harvest is not a management objective, per se, rather it follows from (and is a constraint on) the planned annual harvests. That the inventory will not return to levels present in the

---

5. It is assumed here that the concept of maintaining the capital base by liquidating timber and investing the proceeds in some other form of capital, such as risk free financial instruments, or social/public infrastructure, is not acceptable. Implicit in this view is the objective that capital should be maintained in the forest, regardless of the comparative rate of return between forest capital and other forms of capital. In Chapter 4 this assumption is replaced with the capital base more broadly defined to include other categories of assets.

6. There are concerns in many parts of British Columbia that it will not be possible to maintain harvests at non-declining levels, and that there will be a **falldown** as the transition from old growth to second growth harvests is made. In this regard it is important to note that while **falldowns are expected, they are not at all certain.** It is frequently assumed that present harvest levels are above those which will be supported by long run sustained yield. But some recent evidence indicates that assumption may not always be appropriate, and there are suggestions that with better information on growth and yield long run sustained yields may be higher than is presently anticipated. Certainly the experience in the United States has been that realized growth rates have been well in excess of projections. See: Sedjo, R.A. 1990. The Nation's Forest Resources, Resources for the Future, Washington, D.C.

unmanaged old growth forests follows from the deliberate decisions about the age at which second growth forests will be harvested.

It can then be asked whether this declining forest inventory is a reason for concern, and whether it does mean that the forest capital base is not being sustained for future generations. If the criteria (maximum MAI) used for planning harvests so that the long run sustained yield is maximized is accepted, then it would seem that the concern about sustaining the capital base should not be focussed on the timber inventory. That concern could perhaps be more appropriately focussed on the underlying **forest land and its growing potential as the true capital base of the forest**, not the growing stock of trees. Sustaining the capital base might then be defined as ensuring that the land is managed so that, over time, the sustainable volume of harvests is maximized. This requires a focus on growing potential, as opposed to standing stock or inventory, as the capital base to be sustained.

3.1.2 Potential Annual Harvests From the Forest Estate

The pilot study addresses the issue of rate of harvest and maintenance of the forest capital base by exploring a wide range of forest management options. These options are selected on the basis of forest harvesting and silviculture criteria that could reasonably be considered in managing the forest estate. Many possible combinations of factors, including the area to be considered available for harvests, the age at harvest (rotation period), harvesting methods, harvesting/utilization standards and silvicultural intensity, have been considered. The result has been that 12 forest management options were developed for analysis.

The first four options are grouped together on the basis of common factors in order to demonstrate the effects of silvicultural intensity on sustainable harvest levels. The common factors to each of these options are selection of the age at harvest to maximize the mean annual increment (MAI), use of clearcut harvest practices, and removing timber to the present close utilization standard. Given these common elements, the analyses then test the effect of the following silviculture regimes:

- Option 1: Natural regeneration;
- Option 2: Basic silviculture;
- Option 3: "Select" silviculture;
- Option 4: "Maximize MAI" silviculture.

Natural regeneration implies in effect no silvicultural effort, with complete reliance on the forests to re-establish themselves for future harvests. Basic silviculture reflects the present minimum standards required by the Ministry of Forests, which are essentially that cutover lands be restocked promptly either by planting or natural regeneration. Select silviculture involves planting after harvest and subsequent spacing and fertilizing aimed at increasing wood production but with some constraints on the amount of expenditure. The maximize MAI level of silvicultural effort involves more fertilizing than select silviculture, and pursues stand treatments that increase the production of wood fibre without regard to financial constraints.

The fifth through seventh options also have the age at harvest selected to maximize the MAI and use clearcut harvest practices. The analysis in these options is used to demonstrate the effects of relaxing, or lowering, utilization standards. The first four options adopted the close utilization requirement of 17.5 cm diameter at breast height (DBH) for all species except lodgepole pine, which is 12.5 cm. In options five through seven this standard is relaxed so that no species are harvested before an average 27.5 cm DBH is attained. On the basis of these common elements, the analyses indicate the harvests that are attainable with the following levels of silviculture:

- Option 5: Natural regeneration;
- Option 6: Basic silviculture;
- Option 7: Select silviculture.

The eighth option analyzed explores the implications of managing for an "old growth" forest. This is done to indicate how the uses of the forest would be affected if the timber stands were grown to advanced age before harvest, and the growing forest consisted of considerably older trees than would be the case under conventional management. To do this the age at harvest for trees growing on good sites is set at 150 years, for medium sites at 175 years, and for poor sites at 200 years. Clearcut harvest practices, close utilization, and basic silviculture are assumed for:

- Option 8: Old growth forest.

The ninth and tenth options examine the implications of using a "shelterwood" harvest practice, as an alternative to clearcutting. The shelterwood harvest technique involves removing only a part of the available timber in a stand in a first harvest pass, leaving 30 percent of the trees to "shelter" the naturally regenerating seedlings from harsh micro-climate

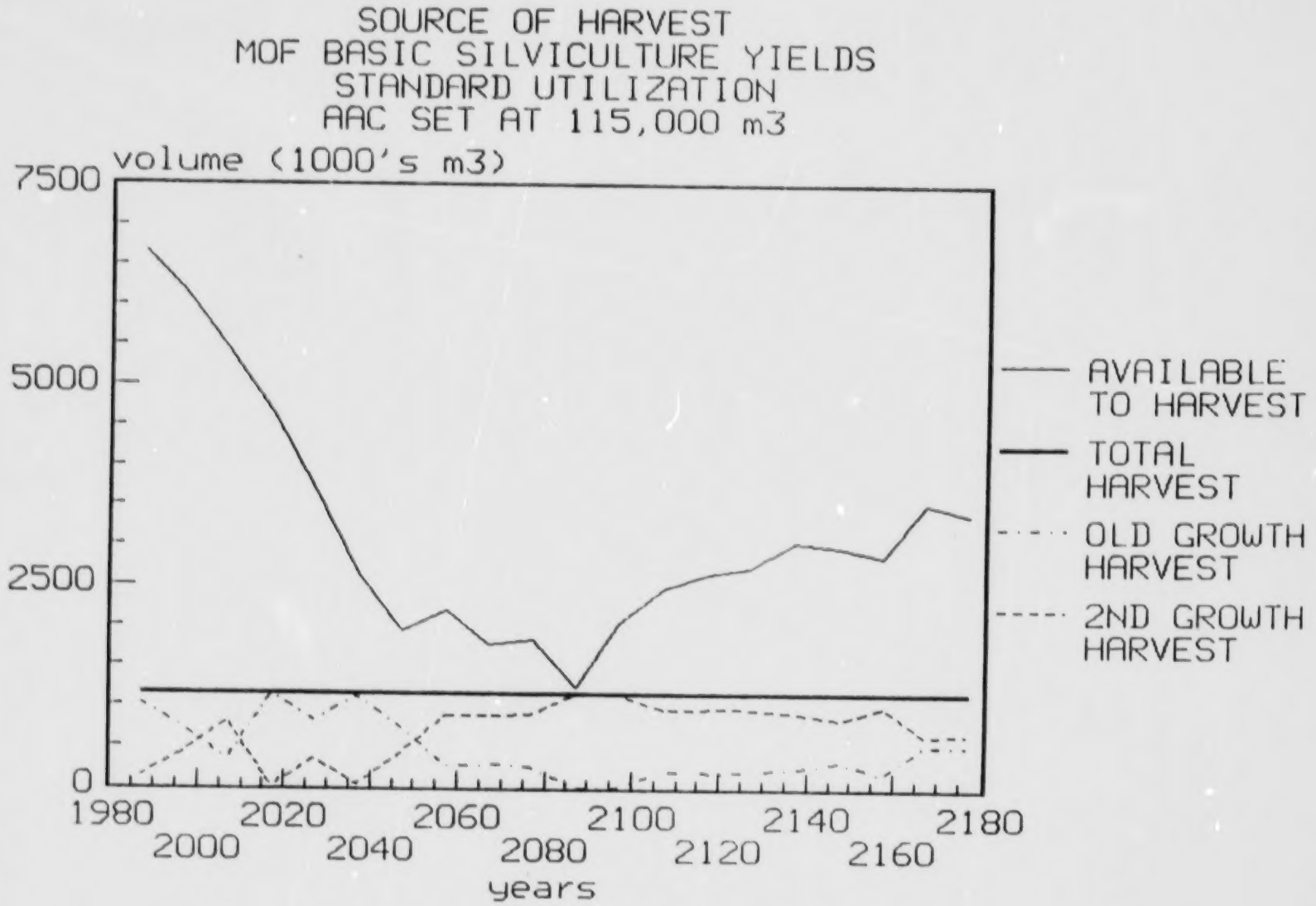

SOURCE OF HARVEST
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 115,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

FIGURE 3.3

conditions. After perhaps 20 to 25 years, when those seedlings are well established, the trees initially left to provide shelter are harvested. For these options the age at harvest is selected to maximize MAI and close utilization standards are assumed. The shelterwood harvest practice is examined for two levels of silviculture effort:

- Option 9: Shelterwood harvest, basic silviculture;
- Option 10: Shelterwood harvest, select silviculture.

Options 11 and 12 de-emphasize timber management and make recreation and wildlife, respectively, the focus of forest estate management. Timber harvests are continued, with clearcut harvest practices and basic silviculture, but only on areas that are not considered central to these other activities:

- Option 11: Recreation management;
- Option 12: Wildlife management.

Each of these options has been analyzed with FIBRPLAN-III, to determine the non-declining annual allowable cut (AAC) that can be sustained and the forest inventory (timber available for harvest) that is maintained. An indication of the "state of the forest", showing its composition by age class over time, is also developed for each option. Presentation of the results is restricted to a 200-year time period, although the model indicates that the patterns revealed will be repeated (with diminishing variations), and should be sustainable indefinitely.

Detailed results are provided here for Option 2, as it incorporates the basic level of management inputs that can be considered a benchmark on Crown forests, given present Ministry of Forests policies. The results of the remaining options are then included with Option 2 in a summary table.

Three figures are presented to summarize some basic results of the Option 2 management plan. **Figure 3.3**, opposite, indicates the annual harvest levels of 115 000 m^3, and the timber inventory, defined as timber available (old enough) to harvest. This figure is repeated from Section 3.1.1 where it was used in reviewing the relationship between harvests and timber inventory and the concept of the "capital base" of the forest estate. The essential elements are the non-declining annual harvest which can be sustained indefinitely, and the varying forest inventory that results from harvest decisions.

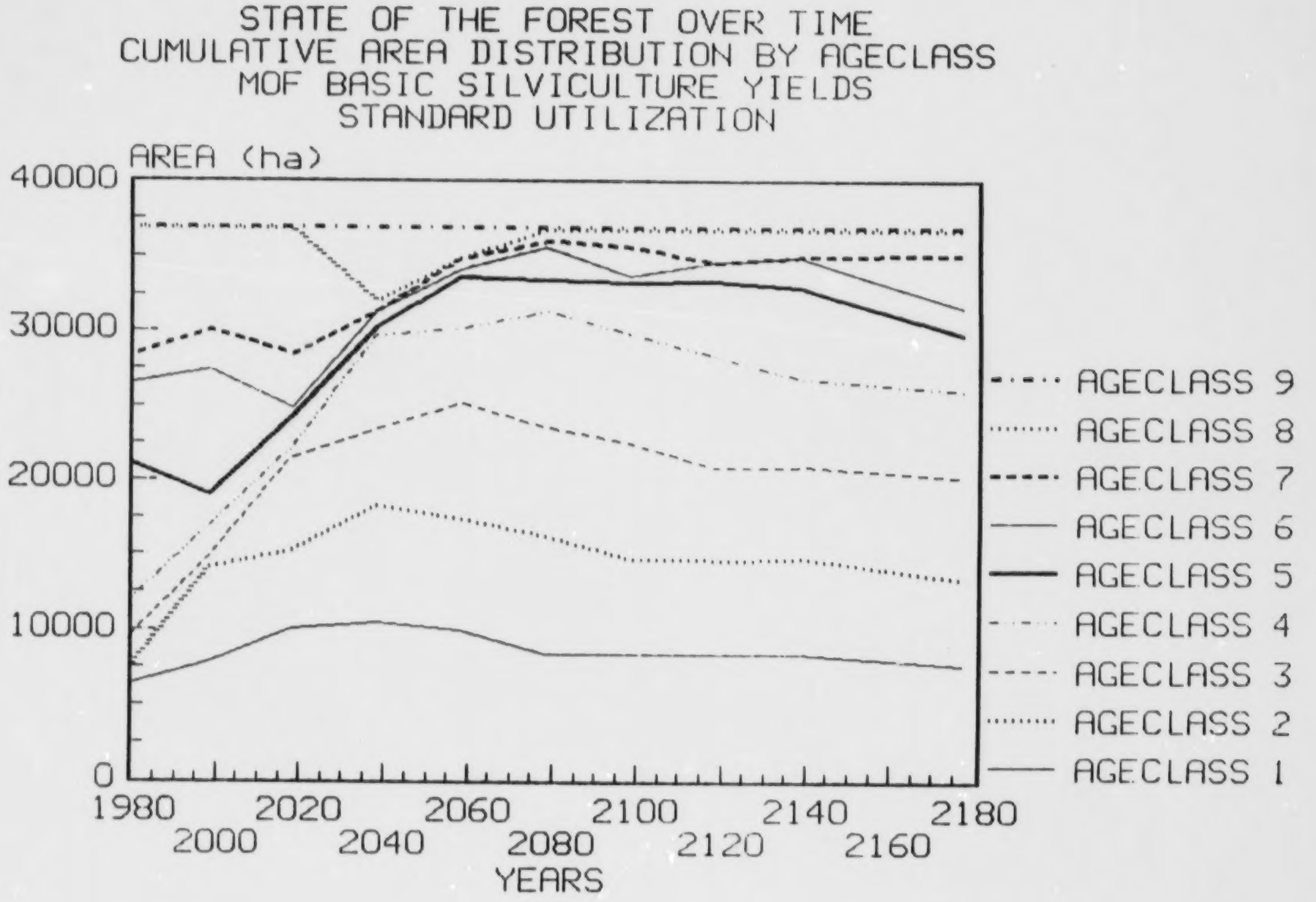

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

FIGURE 3.4

Figure 3.4, opposite, illustrates the composition of the forest over time, by showing the area of the forest occupied by stands of different age classes. **Figure 3.5**, following, provides another perspective on the composition of the forest, by indicating the volume of timber available to harvest by age class.

The pilot study analysis has produced similar figures for each of the 12 forest management options analyzed, and these are presented in **Appendix II**. A summary of the key aspects of the harvest levels is presented in **Table 3.1**. The first column presents the average annual harvest (AAC) that would be supported by the forest over the 200-year period of analysis. For some of the options this average does not represent a harvest that is taken in each year, however. In some options harvests increase over time, as the transition between old growth and second growth stands is made, and as the results of silviculture efforts become available to harvest. The detailed time path of harvests is shown for each option in **Appendix II**. For those options where harvests increase over time, **Table 3.1** simply indicates the various harvest levels which are reached, and which are imbedded in the average annual figure.

The analyses that have been carried out allow the management options to be evaluated with respect to some of the fundamental concerns identified by the Commission. In regard to the concern about harvest levels, the FIBRPLAN-III analyses indicate that there is a wide range of annual harvests which are sustainable indefinitely. Average annual harvests range from as low as 55 000 m^3 per year (Option 5, with a relaxed utilization standard and no silvicultural effort) to 174 500 m^3 per year (Option 4, with close utilization standards and "maximum" silvicultural effort). These figures are averages, and as the summary in **Table 3.1** also indicates, over time it would be possible to reach harvest levels somewhat above the averages.

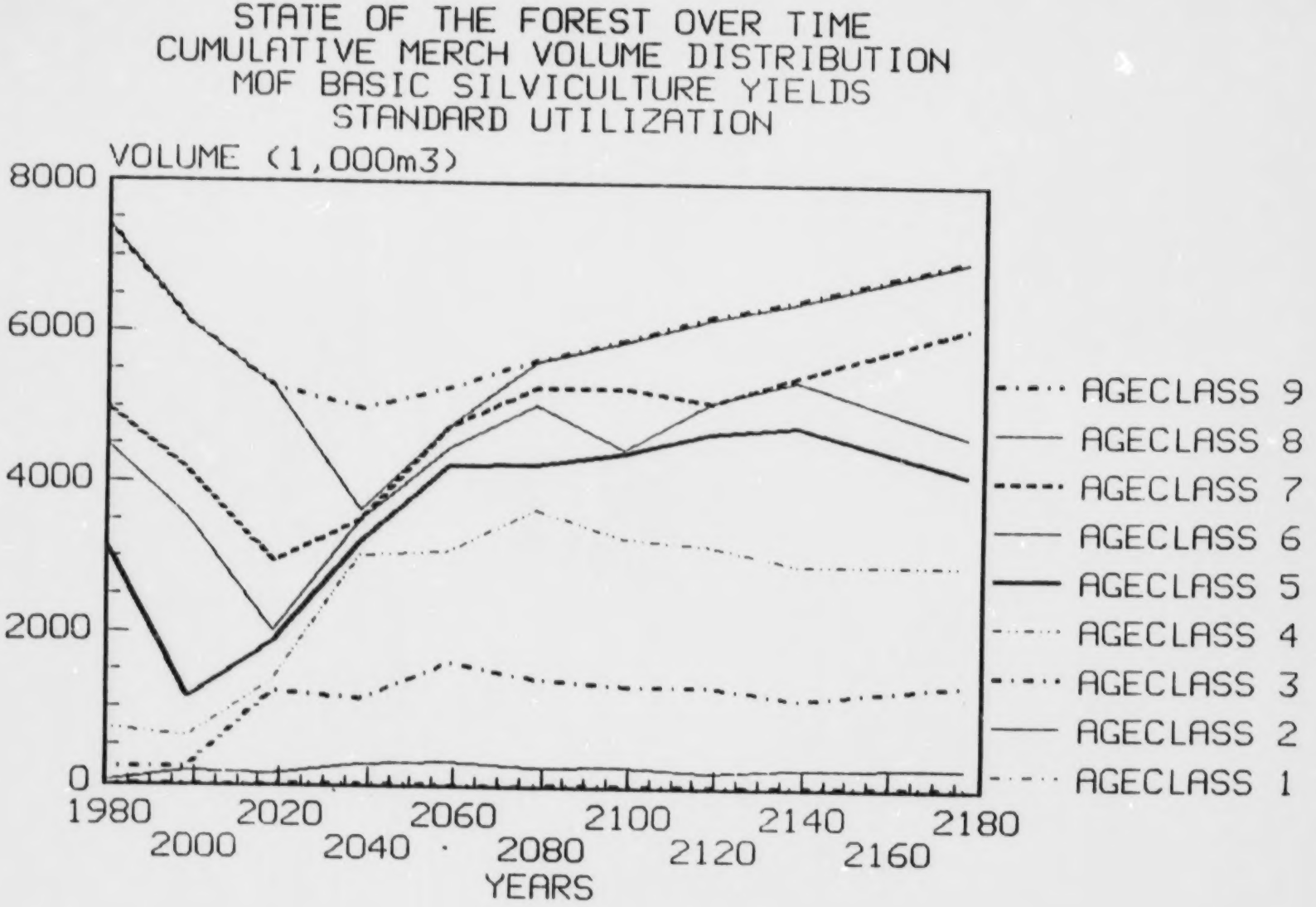

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
VOLUME (1,000m3)
8000
6000
4000
2000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

FIGURE 3.5

TABLE 3.1
COMPARISON OF HARVEST OPTIONS

OPTION	AVERAGE ANNUAL HARVEST (m^3)	HARVEST SEQUENCE (000 m^3)
Alternate Silviculture Regimes at Close Utilization		
1 Natural regeneration	105 000	constant
2 Basic silviculture	115 000	constant
3 Select silviculture	131 300	120/135/150
4 Full silviculture	174 500	133/200/220
Alternate Silviculture Regimes at Relaxed Utilization		
5 Natural regeneration	55 000	constant
6 Basic silviculture	79 000	65/105
7 Select silviculture	79 500	60/80/100
Old Growth Harvest Age, Basic Silviculture, Close Utilization		
8 Old growth forest	89 700	80/100
Shelterwood Harvesting Practices, Close Utilization		
9 Basic Silviculture	130 800	115/150
10 Select Silviculture	149 000	140/160
Alternate Management Emphasis		
11 Recreation	96 600	95/110
12 Wildlife	97 200	90/105

The levels of harvest depend heavily on the intensity of timber management, and on other management criteria such as the utilization standard and age at harvest. Each level of annual harvest could be the result of a rational choice with respect to these management criteria.

To the extent that the concern about harvest levels that the Commission has identified has arisen from Ministry of Forests' practices in setting allowable cuts, the analysis of options does not address it directly. That is because the harvest levels are not determined using the Ministry's methods. To deal with this we have reviewed how an allowable cut would likely be set by the Ministry, if the estate were managed as a timber supply area (TSA). This indicates that the annual harvest would likely be set at about 83 000 m^3.

The FIBRPLAN-III analysis reveals that significantly higher levels of cut than those which would be set by the Ministry could be sustained indefinitely by all options which incorporate a harvest standard based on close utilization. This includes the options (11 and 12) in which a part of the forest is withdrawn from harvesting for other management purposes. This indicates that, for this particular forest estate, harvests as set by Ministry of Forests methods would be sustainable indefinitely.

The results of the analyses as presented in **Appendix II** also shed some light on the related concern expressed by the Commission, regarding maintenance of the forest capital base. If that concern is focussed on the growing stock of timber (expressed in this analysis as timber available for harvest), several important considerations are revealed.

First, the measurement of inventory as harvestable timber will vary greatly depending on the standard of utilization, harvest age and yield function that is assumed. This is evident from comparison of the figures in **Appendix II** relating inventory and harvests for Options 1 through 4, which assume close utilization, with those for Options 5 through 7, where a relaxed utilization standard is assumed. Where the former indicate starting inventories of some 6.5 million m^3, the latter indicate the starting inventories of only 3.5 million m^3. This highlights that care must be taken in reporting on the inventory, and that there is no absolute measure of the timber stock.

Second, as the figures in **Appendix II** also show, in all analyses the inventory is drawn down substantially from the initial levels, which contain significant amounts of old growth timber. The timber inventory is only rebuilt to levels which approximate those opening inventories in two of the Options (#s 6 and 7, with low harvest/utilization standards) and in

those cases the rebuilt inventory is subsequently drawn down again. But the levels of harvest under each option are sustainable indefinitely.

The discussion of this concern in Section 3.1.1 indicated, with reference to Option 2, that it might be more appropriate to focus concern about maintaining the capital base of the forest on the underlying productive capability of the land, rather than the carried stock of growing timber. The analysis of the balance of the options, as presented in **Appendix II**, gives a practical indication of the importance of that distinction.

The analyses also reveal the impact of harvest or utilization standards on the level of annual harvests. For given levels of silviculture effort, harvests can be increased from 46 percent to 90 percent when harvesting standards based on close utilization (Options 1 to 4) are substituted for those based on a relaxed standard (Options 5 to 7). The increases that can be realized are 50 000 m^3 (from 55 000 to 105 000) with natural regeneration, 36 000 m^3 (from 79 000 to 115 000) with basic silviculture, and 51 800 m^3 (from 79 500 to 131 300) with select silviculture.

Comparisons between Options 1 through 4 also reveal the effects of increasing levels of silvicultural effort. With harvest standards based on close utilization, the average annual cut can be increased from 105 000 m^3 with natural regeneration to 115 000 m^3 with basic silviculture - in both cases the harvest levels being constant over time. With select silviculture average annual harvests rise to 131 300 m^3, increasing from an initial level of 120 000 m^3 to ultimately reach 150 000 m^3. With "full" silviculture treatments average annual harvests are 174 500 m^3, rising from an initial level of 133 000 m^3 to an ultimate level of 220 000 m^3.

Options 9 and 10 are interesting in that they indicate relatively high levels of harvest could be sustained with a shelterwood harvest practice, as opposed to the clearcut practices assumed in all of the other Options.

This summary, which reviews the "biophysical potential" of the forest estate to support timber harvests, provides an important indication of the range of choices available in planning for **timber management** on the forest estate. However, as the discussion has not at this point encompassed many of the implications that are expected to be of critical interest - the financial returns to the forest estate, employment and economic activity generated,

effects on other resource uses, and the like, it does not provide a definitive basis for **forest management** decisions.

3.2 DIRECT FINANCIAL RETURN FROM TIMBER HARVESTS

Several passages cited by the Commission in its Options Paper reflect an expectation that British Columbia's forests would yield a significant flow of wealth to their owners:

> **"..... under careful management heavy taxation need never fall upon the population of the Province.**
>
> **The profits from a permanent Crown timber business should make British Columbia that phenomenon of state craft and good fortune - a country of 'semi-independent means'"**[7]
>
> **"...our forest resources ..... will pay dividends in good years and bad years. There will be no failure if proper busin principles are used in their management."**[8]

In the ensuing decades, development of the province's forests has been a principal engine of economic growth. But questions are repeatedly raised about whether the "dividends" paid are adequate, and whether the direct returns from timber have let British Columbians avoid heavy taxation and live as residents of a "country of semi-independent means".

This concern emerges clearly in the Commission report - people wonder whether **"the province is receiving a fair return from timber harvests"**. Specifically, they wonder whether the Crown is receiving adequate **direct payment, as stumpage**, for the timber that is harvested.

If the forest was managed purely from a private perspective, a basic management objective would undoubtedly be to maximize the net direct financial returns from timber harvests. **Table 3.2** summarizes the indicators that have been developed to indicate the financial performance of the various options, the average net revenue per year, and the revenue per m^3 harvested.

---

7. Final Report of the Royal Commission of Inquiry on Timber and Forestry 1909-1910; F.J. Fulton, Chairman

8. E.C. Manning, Chief Forester of British Columbia, from a 1937 address to the Vancouver Board of Trade.

TABLE 3.2

DIRECT NET REVENUE BY MANAGEMENT OPTION

	OPTION	AAC (000 m^3)	AVERAGE NET REVENUE (000S)	REVENUE PER m^3
Alternate Silviculture Regimes at Close Utilization				
1	Natural regeneration	105	$1,450	$13.81
2	Basic silviculture	115	1,370	11.91
3	Select silviculture	131.3	1,370	10.43
4	Full silviculture	174.5	1,717	9.84
Alternate Silviculture Regimes at Relaxed Utilization				
5	Natural regeneration	55	920	16.73
6	Basic silviculture	79	1,040	13.16
7	Select silviculture	79.5	1,180	14.84
Old Growth Harvest Age, Basic Silviculture, Close Utilization				
8	Old growth forest	89.7	1,250	13.93
Shelterwood Harvesting Practices, Close Utilization				
9	Basic Silviculture	130.8	1,055	8.07
10	Select Silviculture	149	1,447	9.71
Alternate Management Emphasis				
11	Recreation	96.6	1,220	12.63
12	Wildlife	97.2	862	8.87

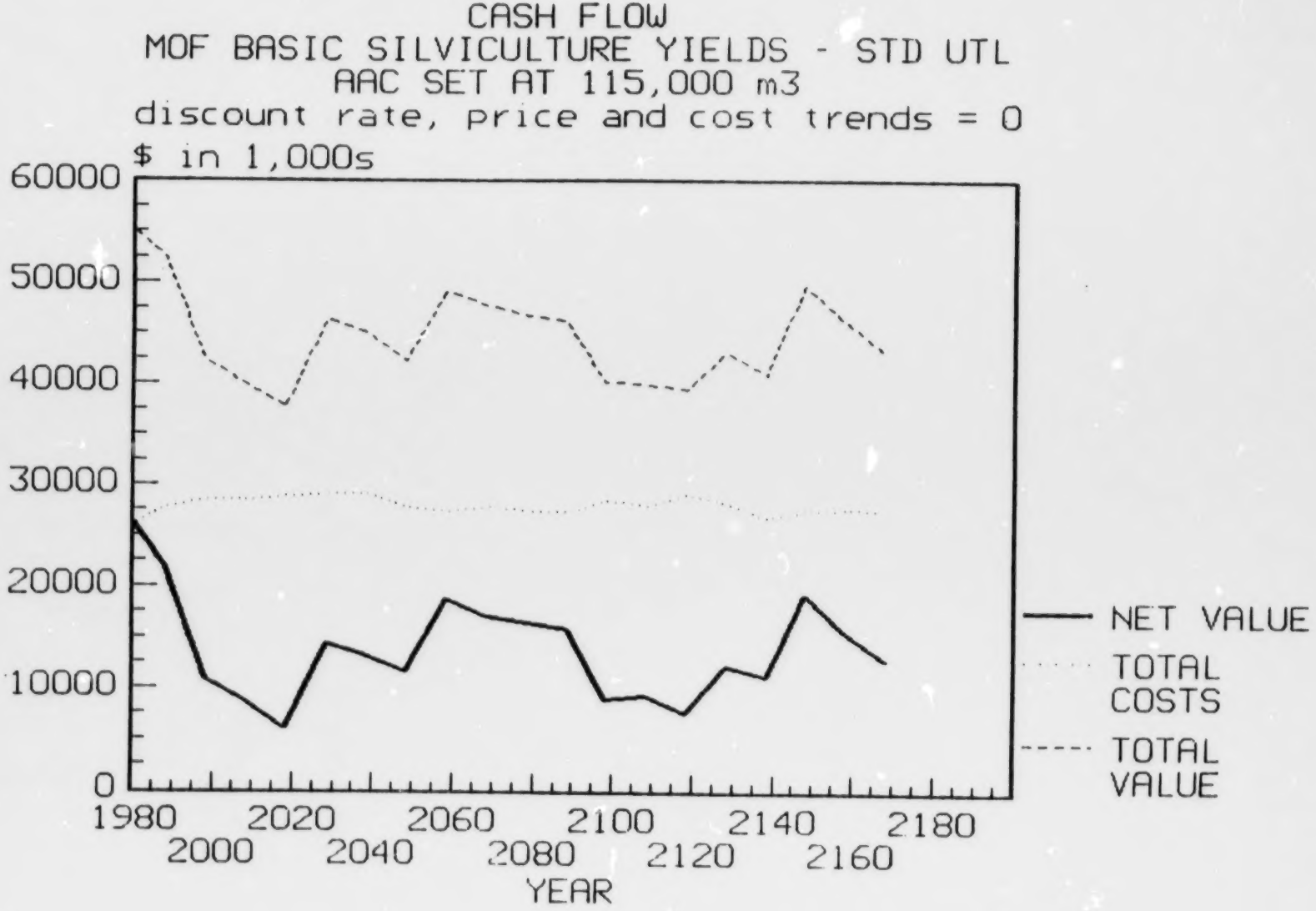

CASH FLOW
MOF BASIC SILVICULTURE YIELDS - STD UTL
AAC SET AT 115,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
60000
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

FIGURE 3.6

As discussed in defining the indicators in Section 2, the average net revenue, or net value generated, measures the direct cash flow to the forest estate. It is derived by deducting from the estimated value of the timber harvested all of the harvesting and management costs.

The average revenue figures in **Table 3.2** conceal wide variability over the 200 years that have been analyzed for each management option. **Figure 3.6**, opposite, indicates how the net annual returns (cash flow) vary over time for Option 2. While the average annual return is $1,370,000, extremes in returns occur relatively early in the period of analysis. Net returns are in excess of $2.0 million during the first 10 years, when high valued old growth timber is selected for harvest. The lowest average returns, in the order of $0.6 to $0.8 million per year, are realized from roughly the 30th to 40th year. Returns continue to be quite variable throughout the balance of the 200 years analyzed. The patterns of cash flow or net value generated are similar for the other options, and the results for each are presented in **Appendix II**.

A number of factors explain this variability in income. It in part results from the selection of timber to harvest by FIBRPLAN-III, which will harvest higher valued stands of timber before lower valued stands. Income fluctuations arising from this strategy could probably be reduced somewhat during actual management of the forest estate, by changing the selection of stands to be harvested, but all variability will not be removed. This indicates that despite the dedication to a stable non-declining harvest, income stability cannot be guaranteed.[9]

In a privately owned forest all of the net revenue would accrue to the owner. On Crown forests, where timber is harvested under license, some of the net revenue would be appropriated as stumpage, and some would be left, as profit, in the hands of the licensee. The pilot study is not designed to investigate the question of how to collect or charge for the timber that is harvested. That has been investigated repeatedly[10]. The pilot study can, however, provide insight into some of the important factors that will determine how much

9. Moreover, since the costs and revenues are analyzed in constant 1990 dollars in the pilot study, greater variability would actually be experienced over time as fluctuations in the business cycle affect forest industry costs and returns.

10. Task Force on Crown Timber Disposal. 1974. Timber Appraisal, Policies and Procedures for Evaluating Crown Timber in British Columbia; Ministry of Forests. 1980. Alternatives for Crown Timber Pricing, A White Paper for Discussion Purposes; Ministry of Forests. 1990. Stumpage Appraisal Information Paper No. 1, Comparative Value Timber Pricing.

value is potentially available to be collected from the timber harvests. These factors are the criteria used to determine which trees must be harvested from any given stand in the forest[11], and the level of expenditure on silviculture.

3.2.1 HARVEST OR UTILIZATION STANDARDS

Left to their own devices forest owners would harvest and deliver to a log market or processing plant only those logs for which the selling price was greater than variable harvesting costs. That is, the harvesting or utilization standard would be implicitly set by economic considerations as to which logs are worthwhile to harvest. Many stands containing inferior timber (low value or high cost) might not be harvested, or if harvested only some of the timber would be taken.

The aftermath of harvesting to an economically determined standard may appear to be wasteful, however, for the very reason that some stands are not harvested, and some logs (from trees cut down for silvicultural or other purposes) are left to rot. The Options Paper reflects opinions of this sort expressed to the Commission: "... harvesting waste which perpetuated the myth of super-abundance ... large volume of wood left to rot after harvesting meant that companies had to cover a wider area to realize their allowable cuts".[12]

This is not necessarily waste in an economic sense, however. To the contrary, to harvest stands or deliver logs to the market for which the value is less than the costs of harvesting can be said to be economically wasteful, insofar as the resources used in harvesting and delivery are more valuable to society (as judged by their prices) than the logs obtained. This type of waste or net economic loss is not visible, however, in contrast to the apparent waste in the aftermath of harvesting to economic standards. This asymmetry has lead to the adoption of utilization standards that require removal and processing of timber that might not otherwise be taken.

---

11. In Crown forests this will be determined by the utilization standard, which defines the timber that must be removed from the forest and processed. By definition in any stands selected for harvesting, trees that will yield logs within the utilization standards must be harvested.

12. Options Paper, p. 25.

It is also recognized that as the volume of wood "wasted" decreases, and the volume processed increases, so do opportunities for employment - directly in the forest industry, indirectly in support and related industries, throughout the province. Harvest/utilization standards are thus seen as laudable on two accounts - they prevent physical waste and expand economic activity.

Private companies harvesting timber could not sustain themselves if forced to undertake such financially unrewarding activity, however. But they have not been averse to the imposition of utilization standards as long as they have in effect been compensated for what they lose on "uneconomic" timber by reductions in what they are required to pay for "economic" timber. This position was clearly enunciated in the following passage[13]:

> ... professional foresters support the theory that submarginal stands either should not be logged or else logged by selective methods. On the other hand, submarginal logs have been, and are being, removed when grown in profitable stands. This policy has been in effect ever since 1947 ...
>
> However, I suggest that industry supports the standard of removing submarginal logs from profitable stands, not entirely for fire protection or site preparation purposes, but for the derivative revenues obtained from every cubic foot of usable fibre processed in manufacturing plants in this province. **Naturally, I am assuming that the additional cost necessary for the removal of marginal fibre is included in the stumpage appraisal.**

As long as the extra cost of removing uneconomic logs is allowed as a deduction in stumpage appraisal, reducing the amount that must be paid for the economic timber harvested, the forest industry has supported utilization standards.

It is difficult to determine the "additional cost necessary for the removal of marginal fibre", and the extent to which it reduces the direct stumpage payments the province receives for timber harvested from the "profitable" stands. Some observations indicate that the cost may be significant. One study,[14] analyzed a 2.2 hectare (5.5 acre) site on northern Vancouver

13. W.G. Burch, in "Comments and Viewpoints", p. 212 of W. McKillop and W.J. Mead, eds. 1976. Timber Policy Issues in British Columbia, University of British Columbia Press.

14. R.S. Uhler and P.D. Morrison. 1986. Utilization Standards and Economic Efficiency in British Columbia Forests. Forest Economics and Policy Analysis Project, University of British Columbia.

Island which had been logged to Ministry of Forests Close Utilization (CU) Standards[15]. The analysis compared the logs removed under Close Utilization with what would have been removed under an "economic standard" of utilization. The economic standard was defined to involve removing each log that had a value at least equal to the marginal cost of removing it.

The study found the differences between harvesting to close utilization and the economic standard as follows:

	CU Standard	Economic Standard
# of logs recovered	808	339
volume recovered	1,203 m^3	795 m^3
net value from site	$ 1,335	$ 7,690
net value per m^3 recovered	$1.11	$ 9.67
net value per log	$1.65	$22.68

These comparisons indicate that the "additional cost necessary for the removal of marginal fibre" was significant. The total value which could have been captured if the site was harvested to an economic standard, $7,690, was reduced to only $1,335 and the difference effectively "spent" to cover the cost of removing non-economic logs to the CU standard. The average net value per m^3 of timber removed was only $1.11 under the CU standard, whereas it would have been $9.67 under an economic standard of utilization.

The implicit tradeoff between direct payments for timber and volume is also clear. The volume recovered from the site was increased by about 50 percent by going from an economic standard to the CU standard (from 795 m^3 to 1203 m^3), and economic activity associated with timber harvesting and processing would have increased accordingly. This increase in economic activity was achieved at the cost of most of the direct net value available from the site.

When concern is expressed about whether the province is receiving a fair return, in terms of direct stumpage payments per m^3 of harvest, it is important to recognize that the potential

15. At that time the CU standard required that all trees with a diameter at breast height of 22.5 cm (on the coast) and 17.5 cm (in the interior) or more be recovered from a logging site. In addition all of the tree between a stump 30 cm high and a top diameter of 10 cm must be removed.

value that can be attained may be compromised by the pursuit of other objectives. This is clearly indicated as a potential result of enforced utilization standards, which may tradeoff direct **value** available, for a greater **volume** of timber harvested.

In establishing a management program for a particular forest estate, one would expect the standard for timber harvests, in light of its consequences for both net direct value available as stumpage and volumes harvested, to be carefully determined. This pilot study is not designed for an in depth assessment of these matters. But it is possible to examine the effects of different utilization standards in order to understand the direction of effects on both value and volume.

To do this, the results of Option 1, which assumed a Close Utilization standard are compared with those for Option 5 in which only larger, higher valued, trees are harvested, as explained previously. The comparison is made using the natural regeneration analysis as in this way the results focus solely on the implications of changes in the utilization standard and the effects of expenditures on silviculture on the value available are removed.

The comparisons, in terms of annual harvests, annual net value available from the forest estate, and value per m^3 harvested, are:

	OPTION 1 CU STANDARD	OPTION 5 RELAXED STANDARD
AAC	105 000 m^3	55 000 m^3
Net value from site	$1,450,000	$920,000
Net value per m^3	$ 13.81	$ 16.73

These results are not unexpected. If harvests take only high valued large timber, the forest estate could only support annual harvests of 55 000 m^3 on a perpetual basis. The average annual net value available from timber harvests would be $920,000, and the value per m^3 harvested would be $16.73. When smaller trees are taken under the CU standards, the sustainable harvest level rises to 105 000 m^3 per year, the average annual net value available from timber harvests rises to $1,450,000, and the average value per m^3 harvested falls to $13.81. Corresponding to the increased annual harvest volumes, the economic impacts and

indirect government revenues, would be almost twice as large under the CU standard as with the relaxed standard.

This comparison indicates clearly how the net value per m^3 of timber harvested falls as utilization standards become more stringent. On the first 55 000 m^3, harvested to the relaxed utilization standard, the average value per m^3 is $16.71. When an additional 50 000 m^3 are added, at the CU standard, they add $516,000 to the total annual value, or only $10.32 per m^3. The effect of blending these two "mixes" of timber together is to achieve an average value of $13.67 per m^3.

The analysis is not sophisticated enough to indicate whether a higher net annual value is attainable from the forest estate by employing an intermediate utilization standard between those considered. It is possible that under the CU standard some of the timber being removed is worth less than the cost to harvest it, and the net annual value available is reduced as a result. If so, there would be a harvest plan involving lower annual harvests than under the CU standard which would generate annual returns higher than the $1.4 million.

Despite the limited scope of this examination of harvest and utilization standards in the pilot study, it does indicate clearly that their selection will have strong implications for the attainable revenue per m^3, the total annual revenue available, and the annual harvest volume from the forest estate. Those developing the management plan would want to be aware of these relationships, and recognize that they could not set targets for direct revenues per m^3 of harvest independent of other targets regarding the standard of utilization and the volumes of wood harvested.

3.2.2 RETURNS TO SILVICULTURAL EXPENDITURE

Table 3.2 and **Figure 3.5** illustrated what we have defined as the net value, or "cash flow", that would be available from timber harvests under management option 2 (close utilization, basic silviculture, 115 000 m^3 AAC). It is derived by deducting all of the current harvesting and management costs from the estimated value of the timber harvested. Silviculture costs are included as current management costs, although they should more properly be analyzed as investments, with the returns to current expenditures being realized in the future. This

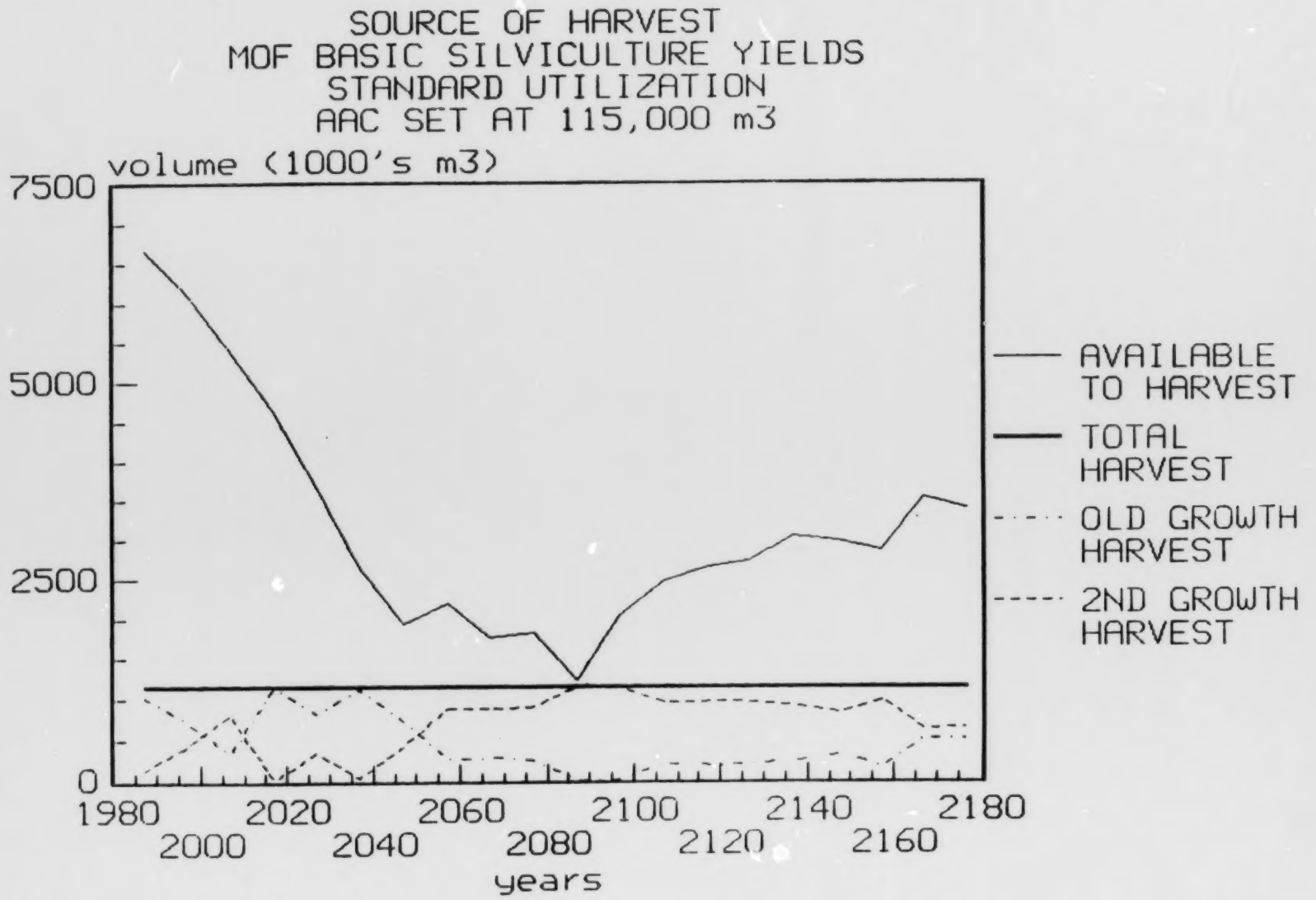

SOURCE OF HARVEST
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 115,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

FIGURE 3.7

kind of investment analysis of silviculture expenditures is not done in the pilot study, and as a result the measure of **net value generated** is very much a **cash flow** measure.

The level of silviculture expenditure is an important factor affecting both annual management costs and revenues from timber sales. To examine this, we have summarized the average annual net revenue, and revenue per m^3 harvested, for the first 4 options analyzed. Because the utilization standard and age at harvest are constant across each of these options, comparing them sheds some light on the effects of silviculture.

	OPTION	AAC (000 m^3)	AVERAGE NET REVENUE (000's)	REVENUE PER m^3
1	Natural regeneration	105	$1,450	$13.81
2	Basic silviculture	115	1,370	11.91
3	Select silviculture	131.3	1,370	10.43
4	Full silviculture	174.5	1,717	9.84

Two things emerge from these comparisons: first, as silvicultural effort increases the annual allowable harvests increase; second, this benefit from silviculture is not costless, revenue per m^3 harvested declines steadily as annual harvests increase.

Silviculture effort allows annual harvests to be increased by increasing the volume of fibre that will be available in future years. If the level of harvests that can be sustained during the critical period when the transition from old growth to second growth harvests is made, harvests taken from the inventory of old growth in the initial years can be increased, and the higher levels of harvest can be sustained throughout the forest life. This is illustrated with **Figures 3.7**, opposite, and **3.8**, following, which portray the harvest patterns for Options 2 and 3.

In Option 2 (**Figure 3.7**), which assumes basic silviculture, the timber available during the critical transition period means that harvests are restricted to 115 000 m^3. At that rate of harvest the inventory is gradually drawn down to reach the critical point after about 100 years. In Option 3 (**Figure 3.8**) which assumes select silviculture, increases in the future availability of fibre allow harvests to be increased immediately to 120 000 m^3, and eventually to 150 000 m^3. As a result of the increased rate of harvest the initial inventory

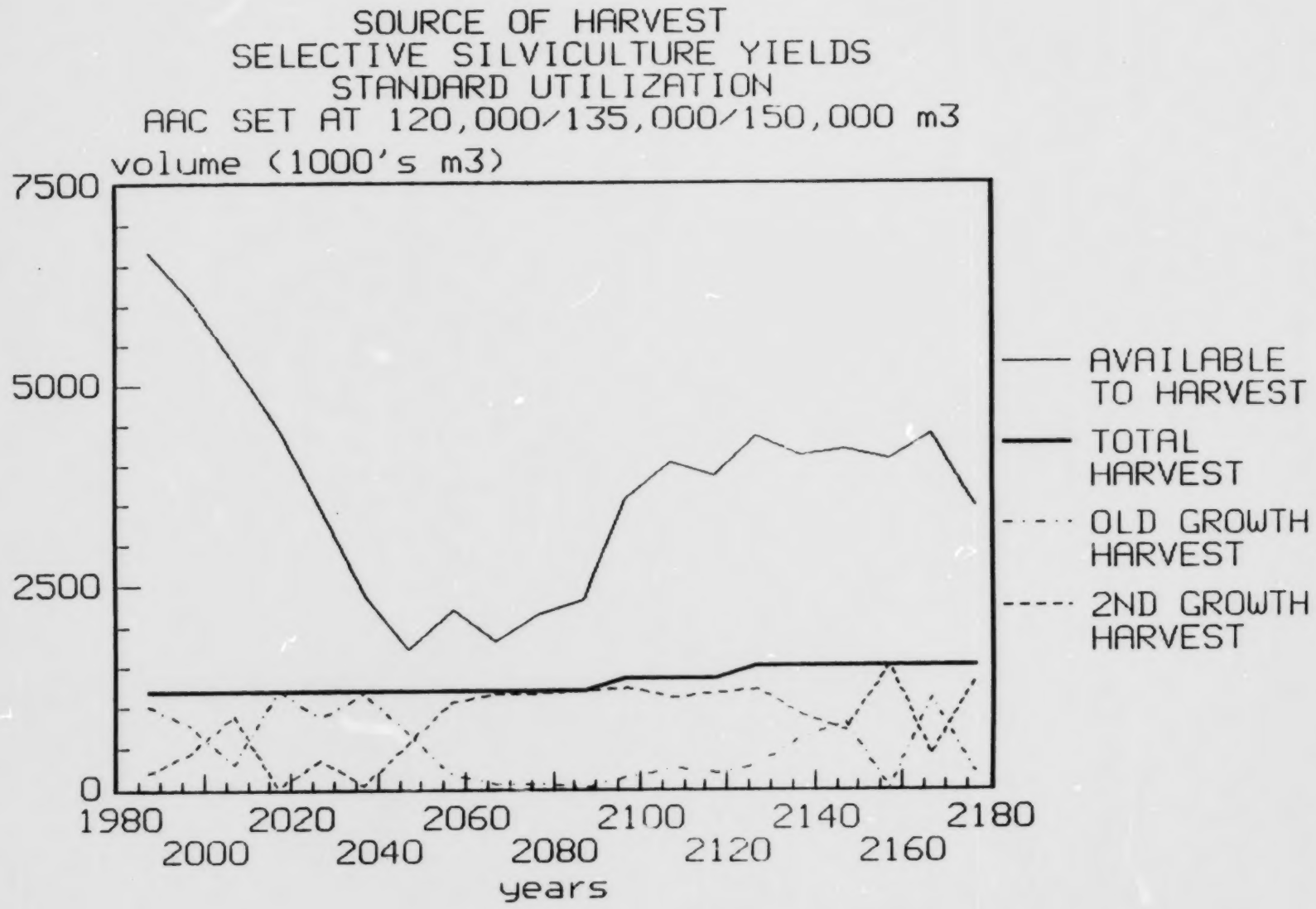

SOURCE OF HARVEST
SELECTIVE SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 120,000/135,000/150,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

FIGURE 3.8

is drawn down more rapidly, and the critical transition point is advanced by about 50 years.

Increased initial harvest can be supported because silviculture expenditures made in the present provide assurance of higher harvest levels in future and we are prepared to draw down the balances in the inventory "bank" more quickly than would otherwise be possible (given the commitment to non-declining harvests). This is commonly referred to as the Allowable Cut Effect, or ACE. How significant such an effect is in any given forest will depend both on the possibilities for silviculture to enhance future production, and what is available in the initial inventory from which increased harvests can be drawn. If the initial inventory of timber available for harvest will not support additional harvests, there will be no Allowable Cut Effect.

As the level of silviculture effort increases, so do the costs. And as the declining revenues per m^3 summarized above indicate, some of the net return that is available from increased harvests is used to pay for the silviculture treatments. In the initial periods this means that a portion of the proceeds from drawing down inventory is used to pay for the future increases in harvest. Whether that is a wise way to invest the proceeds from liquidating inventory is difficult to evaluate from the cash flow figures summarized above and the pilot study analysis.

An initial conclusion might be that the most desirable level of silviculture would be the "full silviculture" reflected in Option 4. This produces the highest average annual harvest and the highest average net revenue, although the average revenue per m^3 is lower than in the other options. It should be kept in mind that these extra harvests are being paid for by liquidating existing inventory, and that the value per m^3 harvested diminishes sharply (the increase in AAC from Option 1 to Option 4 is 69 500 m^3, the increase in net revenue is only $267,000, or $3.84 per m^3). In light of these diminishing returns, and an incremental value per m^3 which is far below the target amount the Ministry of Forests hopes to recoup in stumpage[16], it would seem prudent to query further the wisdom of increasing levels of silvicultural intensity.

16. British Columbia Ministry of Forests. 1990. Stumpage Appraisal Information Paper No. 1, Comparative Value Timber Pricing. The target rates for stumpage from interior forests ranged from $8.59 to $7.88 per m^3 from the fall of 1987 to early 1990.

One way to do this is by a conventional investment analysis where present costs are related to the future returns that they are expected to generate, and the net gain (or value) computed. This can be referred to as an independent "stand level" analysis, dealing only with the actual results from the silviculture treatment and not attributing benefits from an Allowable Cut Effect. To illustrate this, sample calculations have been made on a per hectare basis, for good forest site supporting primarily douglas fir, typical of the forest estate selected for the pilot study.

The analysis involves computing the present worth of expenditures on silviculture, and the corresponding present worth of the additional harvests that can be attributed to the silviculture treatments. This is done by discounting both the costs and returns, using a specified interest or discount rate. If the present worth of the returns is equal to or greater than the present worth of the costs, then it can be said that the rate of return on the silviculture treatment is at least equal to the interest rate used in discounting.

Interest (or discount) rates of 3, 4 and 5 percent have been used in the sample calculations, for each of Options 1 through 4. The results, summarized below, indicate that the return on investment in silviculture, when analyzed at the stand level, is quite low. Natural regeneration, which requires no expenditures, shows a positive net present value for all discount rates. That is because there will be future harvests and they do have a positive present value. Because the harvests are taken almost 90 years in the future, however, that present value diminishes sharply as the discount rate increases.

		NET PRESENT VALUE PER HECTARE AT DISCOUNT RATES OF:		
	OPTION	3%	4%	5%
1	Natural regeneration	$ 331	$ 142	$ 61
2	Basic silviculture	272	(224)	(431)
3	Select silviculture	295	(408)	(694)
4	Full silviculture	(325)	(1,012)	(1,282)

For basic silviculture there is a positive net present value of $272 per hectare at a 3% discount rate, but the values are negative at 4% and 5%. This indicates that the rate of return on investment in basic silviculture is slightly in excess of 3%. The same findings apply to select silviculture, for which a positive net present value of $295 per hectare is

indicated with a 3% discount rate. In the case of full silviculture, however, the net present values are negative at all discount rates. This indicates clearly the diminishing returns noted above - the rate of return on silviculture effort pursued to the "full" level is less than 3%.

Taking a "second look" at the returns to silviculture in this way is a useful exercise. It should be noted that the indicated rates of return are obtained from good forest site land. Returns on medium and poor sites would be lower. The stand level analysis makes clear that in using a cash flow approach, as with the results presented in Table 3.2, old growth stands are being liquidated (through the Allowable Cut Effect) and the proceeds "invested" in silviculture where they earn relatively low rates of return.

Another way to view the silviculture investment is from the estate level. From this perspective there may be an immediate pay-off from incremental silviculture activities in terms of the incremental net revenue from the increased harvest (the ACE discussed above). As noted above, the magnitude of ACE depends on whether a sufficient pool of merchantable inventory is available for harvest. If the net revenue from the incremental harvest is greater than the cost of incremental silviculture (on the entire estate), there is a financial incentive to undertake the additional silviculture. The results presented below were calculated on a comparable basis as the stand results in that the returns are before stumpage is levied.

	SELECT SILVICULTURE	FULL SILVICULTURE
Harvest rate in next 50 years	120	133
"ACE" effect (000 m^3/yr) (in $000's)	5	18
"ACE" harvesting revenues/year	$61	$207
Incremental silviculture costs/year	$172	$685
Net "ACE" revenue/year	($111)	($478)

If the average annual value during the first 50 years had been positive, there would have been a financial incentive to go beyond the basic silviculture regime. However, in both cases, the incremental silviculture costs exceed the incremental revenues from the additional harvest which results in a negative average cash flow before stumpage.

This result is explained by the fact that there is not enough inventory in this particular forest estate to support the full ACE initially. This is clarified below where the long run sustainable harvest, or the full ACE corresponding to the silviculture regime, is substituted. It should be noted that these harvest levels are not attained until over 100 years into the silviculture regime.

	BASIC SILVICULTURE	SELECT SILVICULTURE	FULL SILVICULTURE
Maximum Harvest Rate ('000 m^3)	115	155	197
"ACE" effect (in $000's)	N/A	40	82
"ACE" harvesting revenues/year	N/A	$486	$942
Incremental silviculture costs/year	N/A	$172	$685
Net "ACE" revenue/year	N/A	$314	$257

Given the full ACE, net revenues are greater than the average annual silviculture costs for both regimes. This being the case, the incremental wood could bear some stumpage charge at a reduced rate while still providing some immediate incentive to undertake higher levels of silviculture.

The pilot study is not designed to determine optimal levels of silvicultural effort. It serves its purpose by demonstrating some of the aspects that would have to be considered carefully in deciding on the silvicultural practices to be incorporated in a forest management program. Other aspects, such as the employment and economic activity would also be considered, and are discussed later in this report. We would anticipate that with consideration given to all of these factors, a reasonably sophisticated silviculture program could be designed for the forest estate. Part of that program would undoubtedly be tailoring silviculture treatments carefully to the capability of individual sites within the estate, to obtain the greatest return on the expenditures made.

3.3 MANAGING FOR ALL RESOURCE VALUES

Sections 3.1 and 3.2 discuss how the framework developed for the pilot study can be used to analyze important aspects of timber management - the level of harvests, the financial returns from harvests, utilization standards and silviculture investment. There is a pervasive concern among British Columbians, however, that management must be re-focussed on **forest** management, as opposed to the narrower purview of **timber** management. This concern is identified in the Commission's Options Paper as whether:

> **management practices recognize the full values of commercial and non-commercial uses of the forests.**

Forest practices in British Columbia are routinely modified to take into account impacts on other forest uses and the values generated through fish, wildlife, and recreation resources. But it is commonly felt that these other resource uses are treated as incidental to timber production, whereas they should be given greater recognition and treated as joint products of forest management, not by-products of timber management.

Much would be done to allay this concern if these other resource values were routinely incorporated in the development of forest management plans. Present efforts to do this are not insubstantial, but the results earn few accolades. This probably reflects the fact that "multiple use" is easy to embrace as a guiding principle in resource management, but difficult to implement. Public ownership of most of the forest land in British Columbia, and a commitment to multiple use, leads to all interest groups feeling that they are entitled to have their demands satisfied from the resource base. We have already noted the resulting problem for resource managers:

> **At present, government policy does not specify integrated resource development objectives and priorities. Consequently, the tendency of resource agencies is to manage their resources to the maximum capability of the land. Government must recognize that not all resource objectives can be met.**[17]

In the absence of guidelines as to how to integrate resource development objectives in forest management tendencies have evolved through which tradeoffs and compromises are made without explicit recognition of the relative costs and benefits. The weaknesses inherent in

17. Ministry of Forests. 1980. Forest and Range Resource Analysis Technical Report. Victoria, B.C.

these unevaluated compromises and the need to more rigorously deal with resource integration has been recognized for a considerable time. Noting the diffusion of accountability for resource management and the "... awkward compromises that characterize decisions taken by the consensus of committees." the 1976 Royal Commission Report called for such decisions to be the "... responsibility of an identifiable authority, in the face of the best information and guidance available, to make and stand accountable for decisions about the ultimate plan."[18]

An important part of developing a framework to use in the pilot study has been how to incorporate the full range of resource values into forest management planning. As discussed in Section 2, the forest estate selected for the pilot study has a considerable range of resource capabilities in addition to timber production. These are reviewed at length in **Appendix III**, where the problems with measuring the value of the "non-marketed" resources and understanding the interrelationships between the various uses are also reviewed.

In dealing with non-timber values for the forest estate we have encountered the unevenness of resource knowledge that the Commission noted in its interim report:

> **... good inventory information pertaining to the full range of forest values and to the capacity of the forest land base to support those values is seriously inadequate ..... decision makers and the public have very inadequate and imperfect information on which to base decisions or debate.**[19]

This is particularly the case for the management of fish, wildlife and recreation resources within the forest estate where there is reasonable knowledge about present levels of use, but little on which to base estimates of resource potentials.

Because the emphasis in the present assignment is on development of a framework for decision making, we have seen little point is creating a "fiction" in the pilot study by suggesting that we have sophisticated knowledge about how non-timber values are affected by the different timber management programs. For the first 10 management options that are analyzed, which we characterize as "timber driven", a constant use of other resources is assumed. Thus the analyses assume livestock grazing, support of fish and wildlife, and use

18. Pearse, P.H. 1976. Timber Rights and Forest Policy in British Columbia, Report of the Royal Commission on Forest Resources, Vol. 1, p. 266.

19. British Columbia Forest Resources Commission. July 1990. Interim Report.

of the estate for various forms of recreation to be sustainable at known present levels under present multiple use management.

A number of "indicators" are used to represent these resource uses. For livestock grazing the indicators are the animal unit months of grazing and associated direct employment (3,400 AUM's, 3 man-years). Indicators for wildlife include the over-wintering population of deer (160) and moose (235). Recreation supported by the estate's fish and wildlife resources, plus other recreation opportunities in camping, hiking, touring etc., are all encompassed in the measure of recreation days (currently 12,000) and dependent employment (3 man-years). These indicators remain constant[20] throughout the first 10 management options analyzed - indicating that present levels of multiple use can be sustained within the varying parameters of forest management incorporated in each option.

The final two options analyzed de-emphasize timber production and focus on realizing the potential of the estate's resources for recreation and wildlife.[21] In Option 11 a significant part of the forest, some 9420 ha judged to have the highest recreational capability, is withdrawn from timber harvesting and set aside as a recreation area. This has the effect of doubling recreation activity from 12,000 to 24,000 recreation-days per year, and the employment associated with spending by recreationists increases from 3 to 6 man-years. The balance of the forest remains capable of supporting timber harvests, at a level of some 96 000 m^3 per year, as previously indicated (**Tables 3.1** and **3.2**).

Option 12 emphasizes the production of wildlife on the forest estate. This is done by withdrawing from timber harvesting the key winter ranges which support deer and moose - an area of some 8620 ha. By reserving these areas from timber harvests, and with more intensive wildlife management (regulation of harvests by hunters, enforcement of game laws, etc.), the deer population is more than doubled to 370 (from the present level of 160) and the moose population increases to 470 (present estimate 235). As a result of these increased wildlife populations the number of hunter days is assumed to increase from the present level of 2,800 to some 4,800 days per year. This has the effect of increasing total recreation

20. Modest increases in the populations of deer and moose are assumed in the shelterwood harvest options 9 and 10, and a corresponding modest increases in recreation.

21. We discuss in Appendix 3 the important outstanding issues relating to increasing livestock grazing within the forest estate. While this might be achieved with intensive management, we have been reluctant to indicate this in the pilot study as the economic viability of doing so remains unclear.

activity in the forest estate to 14,000 days per year. As indicated elsewhere (**Tables 3.1** and **3.2**) timber harvests on the balance of the estate continue in this management option, with some 97 000 m^3 per year being taken.

It is recognized that there is much more to managing a forest for the "full values of commercial and non-commercial uses" than is encompassed in these two options. There are important values associated with non-use and preservation, and these are discussed in **Appendix III**, as are concerns about matters such as bio-diversity. But when it comes to actually developing a management plan for a forest these values are not amenable to quantification. It would be expected that non-use values would be higher in options 11 and 12, with land reserved from timber harvesting, than in the other "timber driven" options. And some concerns, such as those relating to the protection of rare landforms, endangered species, and maintenance of diversity can be addressed by incorporating them in the general regulation of all forest uses. These would have to be dealt with on a subjective basis, however, in terms of selecting between alternative management options.

It is also recognized that the opportunities to manage for non-timber values on the forest estate selected for the pilot study do not necessarily reflect opportunities available elsewhere in British Columbia. Some forests may encompass lands with more outstanding features and greater capability for recreation and for fish and wildlife production, in some forests the opportunities may be more limited. The important thing in the present case is development of a framework which allows these values to be incorporated when a management program for the forest is developed.

Through the framework it is intended that those who must decide on a management program can take explicit account of the tradeoffs or compromises between different uses, and, as noted in the passage from the 1976 Royal Commission cited above, "... in the face of the best information and guidance available, ... make and stand accountable for decisions about the ultimate plan." How that can be done is addressed in the next section.

3.4 CHOOSING A PREFERRED MANAGEMENT OPTION

To this point the analyses have examined different management options for the forest estate, and have shown how the framework and the pilot study can be used to focus on key management parameters. As the management inputs and priorities change, so do the outputs.

TABLE 3.3

SUMMARY RESULTS OF ALTERNATIVE MANAGEMENT SCENARIOS, PHYSICAL OUTPUT INDICATORS

MANAGEMENT SCENARIO	TIMBER INDICATORS			RANGE INDICATORS		WILDLIFE INDICATORS		RECREATION INDICATORS	
	AAC (000 m^3)	Harvested Land (ha/yr)	Employment (man-years)	Animal Unit months/yr	Employment (man-years)	Deer Pop. (overwintering pop.)	Moose Pop.	User days/year	Employment (man-years)
Alternative Silviculture Regimes at Standard Utilization									
1. Natural Regeneration	105	338	204	3400	3	160	235	12000	3
2. MOF Basic Silviculture	115	336	227	3400	3	160	235	12000	3
3. Select Silviculture	131.3	343	262	3400	3	160	235	12000	3
4. Maximize Wood Production	174.5	416	347	3400	3	160	235		
Allow Lower Utilization Standards									
5. Natural Regeneration	55	270	107	3400	3	160	235	12000	3
6. MOF Basic Silviculture	79	311	157	3400	3	160	235	12000	3
7. Select Silviculture	79.5	255	157	3400	3	160	235	12000	3
Extend rotation period									
8. Old Growth Forest and MOF Basic Silviculture	89.7	249	177	3400	3	160	235	12000	3
Alternative Harvesting Methods									
9. Shelterwood Harvest and MOF Basic Silviculture	130.8	718[1]	258	3400	3	200	295	12500	3
10. Shelterwood and Select Silviculture	149	739[2]	294	3400	3	200	295	12500	3
Management Emphasis Other Resources									
11. Recreation	98.8	253	191	3400	3	160	235	24000	6
12. Range and Wildlife	97.2	255	191	3400	3	370	470	14000	3

Notes:

1. Average harvest 384 ha/year, thinning 334 ha/year
2. Average harvest 406 ha/year, thinning 333 ha/year

It is essential to know what the possibilities for the forest estate are in this way. But ultimately a choice has to be made and a management program selected.

The diverse inputs required and outputs produced under each management option cannot be rendered into a single unit of measurement, or reduced to a common denominator, to determine which is the "best". What was done, therefore, was to develop the various "indicators", which attempt to measure separately the outputs of the forest estate that some value or priority would be assigned to.

The implications of each management option, as measured by the indicators developed, can be summarized and compared in tabular format, and two separate tables have been developed for this purpose. **Table 3.3**, opposite, displays the results of the alternative management options in terms of physical outputs. **Table 3.4**, following, sets out value indicators for the respective options.

The physical measures of output set out in **Table 3.3** include the average allowable cut, average hectares of land harvested each year and employment in forestry[22] as timber indicators. For range use by livestock the indicators are animal unit months of grazing per year, and the employment associated with the livestock using the range. The indicators for wildlife are restricted to overwintering populations of deer and moose. There are no direct indicators for the fish resource. The recreation associated with both fish and wildlife is included with all other forms of recreation in the user day estimates for recreation, as is an estimate of the amount of employment supported by the spending of recreationists.

Few would be prepared to choose among management alternatives solely on the basis of the physical indicators in **Table 3.3**, however, and the kinds of value indicators that would be looked to in order to supplement and round out the physical indicators are presented in **Table 3.4**. For timber indicators the measures presented include the average annual net value generated (the excess of revenue over costs) in terms of an annual total and per m^3. The timber indicators also include estimates of what the province might receive each year, on average, in stumpage, and what both British Columbia and Canada would receive from taxes levied on labor incomes and corporate profits. Two value indicators are also included for livestock grazing, one indicates the total value of the forage consumed by cattle, the other the annual payment received by the province in grazing fees.

22. The employment estimate for forestry includes direct, indirect and silvicultural employment.

TABLE 3.4

SUMMARY RESULTS OF ALTERNATIVE MANAGEMENT SCENARIOS, VALUE INDICATORS

MANAGEMENT SCENARIO	AAC ('000 m^3)	Average Net Value Generated Per Year ('000$)	Average $/$m^3$	TIMBER INDICATORS: Average Stumpage Payment ('000$)	TIMBER INDICATORS: Taxes Labor and Company Taxes/yr B.C. ('000$)	TIMBER INDICATORS: Labor and Company Taxes/yr Canada ('000$)	TIMBER INDICATORS: Imputed Bid ('000$)	RANGE INDICATORS: Net Value of Forage ('000$)	RANGE INDICATORS: Average Grazing Fees ('000$)
Alternative Silviculture Regimes at Standard Utilization									
1. Natural Regeneration	105	$1,450	$13.81	$ 869	$546	$ 820	$8,833	$20	$5
2. MOF Basic Silviculture	115	$1,370	$11.91	$ 953	$538	$ 875	$6,322	$20	$5
3. Select Silviculture	131.3	$1,370	$10.43	$1,104	$852	$ 978	$4,039	$20	$5
4. Maximize Wood Production	174.5	$1,717	$ 9.84	$1,459	$860	$1,290	$3,916	$20	$5
Allow Lower Utilization Standards									
5. Natural Regeneration	55	$ 920	$16.73	$ 495	$294	$ 441	$6,420	$20	$5
6. MOF Basic Silviculture	79	$1,040	$13.16	$ 693	$405	$ 607	$5,192	$20	$5
7. Select Silviculture	79.5	$1,180	$14.84	$ 690	$417	$ 625	$7,420	$20	$5
Extend rotation period									
8. Old Growth Forest and MOF Basic Silviculture	89.7	$1,250	$13.94	$ 748	$467	$ 700	$7,546	$20	$5
Alternative Harvesting Methods									
9. Shelterwood Harvest and MOF Basic Silviculture	130.8	$1,055	$8.07	$1,055	$631	$ 947	$0	$20	$5
10. Shelterwood and Select Silviculture	149	$1,447	$9.71	$1,249	$719	$1,079	$3,007	$20	$5
Management Emphasis Other Resources									
11. Recreation	98.8	$1,220	$12.35	$ 830	$503	$ 755	$5,853	$20	$5
12. Range and Wildlife	97.2	$ 862	$8.87	$ 760	$476	$ 714	$1,548	$20	$5

As discussed in **Appendix III**, for a number of reasons value indicators have not been developed for recreation days. Rather than try to develop indications of the monetary value of what is essentially a non-marketed resource use, the framework is restricted to putting forward estimates of recreation days, as in **Table 3.3**. Instead of asking "How much is the recreation worth?" and attempting to incorporate it in management planning on that basis, the alternative of asking "Is it worth it?", in terms of the impacts on other forest uses that may be curtailed in order to increase recreation, can be pursued by those who must decide.

Simply arraying the "indicators" in this way is far from ideal as a basis for decision making. But it does indicate the kinds of tradeoffs which must be between resource uses in moving from one option to another. For example if a high priority is assigned to increasing the wildlife populations, Option 12 indicates one way in which this can be achieved, the likely "payoff" in terms of additional recreation and employment, as well as the implications for levels of timber production, forestry employment, and so forth. On the other hand, if a high priority is placed on timber production the ways of achieving that (silviculture intensity, utilization standards, harvest methods) are indicated, as are the anticipated consequences for non-timber resources and uses within the estate.

The array of information in this way brings home the truth of the passage cited in Section 3.3. It is important to **manage** for all resources, but it is not possible to **maximize** all resources. Despite the format's awkwardness, it has the merit of making the consequences of the various choices clear, and when choosing an option those responsible can indicate the reasons for giving it preference. If an option resulting in greater timber harvests were chosen in preference to one which allowed a higher level of recreation and non-use value, it would be implicit that the "values" realized through the additional timber production were felt to more than outweigh any reductions in the "values" of recreation and non use that would have to be accepted as a consequence.

The tables also expose attributes of the various options which may stimulate further investigation. To illustrate this, some general comments are made regarding the options and their "indicators" as set out in **Tables 3.3** and **3.4**.

Options 1 through 10 are basically timber driven. Within the domain of timber management, numerous questions may arise. To begin with, are decision makers content to focus on sustainable levels of AAC and ignore the issue of "maintaining the capital stock/inventory"? We have demonstrated in Section 3.1 that the relationships are complex. If decision makers

are not content to focus solely on AAC, perhaps because they do not fully trust the projections of forest growth, the indicators may have to be supplemented with a measure that is a proxy for the average standing stock of growing timber.

With respect to silviculture, the question can be put as to whether it is preferable to pursue the maximum yield of fibre, with average annual harvests of 175 000 m^3 per year, through "full silviculture"? We have analyzed the economic implications of this in Section 3.2. A decision maker would presumably take that into account, along with the estimates of employment and government revenues presented in **Table 3.4**, in deciding on the appropriate silvicultural regime for a forest management program. Given the information that can be mustered, one could decide on the extent to which "economic efficiency" in fibre production was to be compromised for "economic activity" associated with the added harvesting and processing activity.

For any given harvest level the question of the preferred management option could also be addressed. If a harvest of 130 000 m^3 is chosen, what is the preferred management option - Option 3, with clearcut harvests and select silviculture, or Option 9, with shelterwood harvests and basic silviculture?

These are only a few of the questions which might arise within the realm of timber management. They indicate that the first function of the array of indicators may simply be the narrowing of focus to a few key options (ie. some timber management options are decidedly inferior), and a call for more in-depth analysis of the selected aspects of those key options.

Options 11 and 12 reverse the emphasis on timber production, and explore what could be attained through a higher level of management intensity for fish, wildlife, recreation and values associated with "preservation" of forests. There have been ample cautions regarding how poorly understood are the resource inventories and the ways in which these resources and values respond to different levels of management. The limited knowledge in these areas has in turn limited the extent to which management options in which they are the central focus can be developed.

Given that we are operating at a lower level of knowledge than is the case in analyzing timber management, some obvious questions arise nevertheless. Would it be appropriate to make the tradeoffs between these kinds of values and the values associated with timber

harvests that the analyses indicate are required? Do we have better ways of measuring the direct value of the currently non-priced recreation to assist in such decisions? Could we institute a system of commercialization that would both reveal value through prices actually paid, and enhance employment opportunities in fish, wildlife, and recreation management? Are there some fairly simple ways of modifying timber management in the short term so that, should research reveal subsequently that the tradeoffs are justified, the options to make those tradeoffs would not have been foreclosed?

Probably many more questions would emerge from a review of the options for forest management. Used in this way the framework provides a very useful guide to management decision making. It also exposes areas for on-going inquiry aimed at improving the management of the forest over time.

To the extent that the framework succeeds in being value neutral, it has the further merit of leaving the choices to those who are prepared to accept the responsibility for making them. The analysis and the analysts are not allowed to preempt the decision process by assuming priorities and value functions and imbedding them in the work.

4.0 ACCOUNTING FRAMEWORK FOR THE FOREST ESTATE

The last chapter explored an array of forest land management opportunities and their implications. At some point a particular management alternative will be selected and implemented. Implementation should involve a monitoring of management performance relative to initial stated objectives. The Commission makes this point when considering the potential role of Forest Management Agreements:

> "These agreements would feature a contractual requirement to manage for all values in the forest, with annual independent audits of performance. The audit would be used to determine if the licensees should be rewarded or penalized, or the licence cancelled."[1]

The accounting framework would also address a concern noted by the Commission in a number of submissions that "the forest capital base should be sustained for future generations".

This chapter identifies an accounting framework that satisfies these two objectives. The system is comprised of two general formats. The first format expresses the estate's outputs in physical units such as cubic meters of fibre, user days of recreation, animal unit months of grazing. The second general format expresses estate inputs and outputs in commensurable dollar terms such as revenue from log sales and logging costs, user fees and range fees.

The utility of an account framework (physical, or value) depends totally on the accuracy of the data. In order to discern the true position of the forest estate the accounts must contain accurate information, not speculative data. The value accounts could address a wider ambit of activities than is typical of private financial accounts, but these should be represented as objectively as practical.

It is also envisaged that the accounts (physical and value) would be presented in a document similar to a public company's annual report. This document provides information on external factors that have affected performance, which establishes a context for evaluating performance. In addition, estate outputs that may not fit appropriately into an account (e.g. preservation values) may be addressed in qualitative terms.

1. Forest Resources Commission, Options Paper, Sept 1990, page 19.

4.1 THE PHYSICAL ACCOUNT

Given the Commission's perception of a forest management agreement quoted above, it is assumed that an "approved" management proposal will contain a management strategy and explicit targets for the estate's key forest values. It is relatively straightforward to derive a checklist, or an account, to monitor whether the targets are realized in the manner agreed to.

The physical account is an inventory of the estate's key resources. Additions and deletions to the stock of resources over the reporting period (e.g. one year) are included to derive the physical value of the closing inventory. This becomes the opening inventory in the subsequent period. The reporting provides essential information on the physical status of resources over time, but can not be aggregated across resources[2].

The frequency of reporting would depend on how readily the data could be gathered, the underlying population dynamics, and the relative importance of the resource/activity to the fulfilment of the management plan. For example, annual records should be kept on silvicultural activities, timber harvest, and recreation use. On the other hand, total range land would likely not vary greatly on an annual basis, wildlife populations are difficult to census, and measuring actual annual fibre growth would be very onerous. For resources that fall into this latter category, actual counts at 5 or 10 year intervals may be quite reasonable.

It might be noted that the long term harvesting strategy is premised on the timely regeneration of the next crop. It is imperative that fibre growth is monitored by extensive and on-going on the ground sampling.

A second consideration is how frequently the annual report should be audited by an independent body. Practical considerations may dictate the timing. It is important the audit is frequent enough so that past records are properly interpreted. Also, there must be time to correct problems identified by the audit. It is not unreasonable to conduct an audit about every three years. Alternatively, on the assumption that the management agreement will be subject to periodic review, the audit could be timed at the mid-point and at the of the review

2. A materials balance account is also expressed in physical terms, but this is not the sort of physical account considered here. A materials balance account is intended to indicate whether particular key elements (carbon, water, etc.) are on net being conserved or consumed. This may be an important consideration in selecting a management option, but it does not provide the sort of bench mark sought for evaluating implementation.

4.1 THE PHYSICAL ACCOUNT

Given the Commission's perception of a forest management agreement quoted above, it is assumed that an "approved" management proposal will contain a management strategy and explicit targets for the estate's key forest values. It is relatively straightforward to derive a checklist, or an account, to monitor whether the targets are realized in the manner agreed to.

The physical account is an inventory of the estate's key resources. Additions and deletions to the stock of resources over the reporting period (e.g. one year) are included to derive the physical value of the closing inventory. This becomes the opening inventory in the subsequent period. The reporting provides essential information on the physical status of resources over time, but can not be aggregated across resources[2].

The frequency of reporting would depend on how readily the data could be gathered, the underlying population dynamics, and the relative importance of the resource/activity to the fulfilment of the management plan. For example, annual records should be kept on silvicultural activities, timber harvest, and recreation use. On the other hand, total range land would likely not vary greatly on an annual basis, wildlife populations are difficult to census, and measuring actual annual fibre growth would be very onerous. For resources that fall into this latter category, actual counts at 5 or 10 year intervals may be quite reasonable.

It might be noted that the long term harvesting strategy is premised on the timely regeneration of the next crop. It is imperative that fibre growth is monitored by extensive and on-going on the ground sampling.

A second consideration is how frequently the annual report should be audited by an independent body. Practical considerations may dictate the timing. It is important the audit is frequent enough so that past records are properly interpreted. Also, there must be time to correct problems identified by the audit. It is not unreasonable to conduct an audit about every three years. Alternatively, on the assumption that the management agreement will be subject to periodic review, the audit could be timed at the mid-point and at the of the review

2. A materials balance account is also expressed in physical terms, but this is not the sort of physical account considered here. A materials balance account is intended to indicate whether particular key elements (carbon, water, etc.) are on net being conserved or consumed. This may be an important consideration in selecting a management option, but it does not provide the sort of bench mark sought for evaluating implementation.

TABLE 4.1

Physical Account

ESTATE OUTPUT	ACTUAL	TARGET
1. Timber('003m3)		
opening		7234.2
additions		
Growth		76.7
less		
Harvests		115.0
fire, pests		11.5
closing balance		7184.4
summary of silviculture (ha. treated)		
planted		495.0
thinned		0.0
spaced		0.0
fertilized		0.0
2. Range (hectares)		
opening balance		9358.0
additions		0.0
range created		379.0
less		
range lost		
closing balance		9737.0
Range Use (in AUM)		
actual use		3400.0
maximum available		
3. Recreation		
opening balance of		
lands reserved	not available	
facilities	not available	
# campsites	not available	
# of picnic sites	not available	
Km of trails		
Recreation Use (user days)		
hiking	not available	
fishing	not available	
hunting	not available	
4. Wildlife Populations	not available	

Note: 1. State of the Forest report would be appended.

period. The frequency of the audit will become clearer as the parameters of the management agreement are better defined.

An example of the physical account for several outputs was developed for one year using Case 2, MOF basic silviculture, shown in **Table 4.1**, opposite. "Target" refers to the respective value that would be found in the Forest Management Agreement. The estate manager would supply the data on the resources/activities noted. Since the estate manager is in the position to collect a wide array of useful information (relevant from a broader perspective) he might be required to gather it, but his management performance would not be judged on it. Outputs denoted in bold face in the table indicate those resources/activities for which the estate manager must report data and upon which an evaluation is based. The other outputs are for information only.

From **Table 4.1**, it could be concluded from reviewing the annual timber account that this management plan is not sustainable, and that the forest capital base is being run down. It clearly is not sustainable in terms of maintaining a constant volume of fibre inventory. But it is sustainable in terms of maintaining today's constant harvest level. This matter was discussed in detail in the last chapter. The data in **Table 4.1** is from the period 1990-2030 (**Figure 3.1**) when the standing inventory is being drawn down. After 2080, the initial harvest level remains sustainable while the standing inventory is about 50% of its initial volume.

Whereas the concept of "resource sustainability", may be easily grasped, it may prove elusive to measure in particular circumstances. For renewable resources, changes in inventory levels over a year (whether increasing or decreasing) may not alone indicate long term sustainability. A measure of the population's underlying productivity potential may provide a better indicator of sustainability in physical terms. With respect to timber harvests, the appropriate measure is the value of the estate's maximum long run sustainable harvest level rather than inventory levels. Given the level of silviculture activities assumed in this management scenario, the maximum AAC is 115 000 m^3/year. That is, harvests in excess of this volume can not be sustained by this management regime[3].

3. As discussed in the last chapter, the long run AAC can be increased by more intensive silviculture efforts.

4.2 VALUE ACCOUNT

The value account format converts the resource volumes presented in the physical account to dollar values as appropriate. The format can also encompass off-the-estate economic/financial considerations (such as financial loans, third party effects) to accurately describe the overall economic position of the estate. The conventional financial statement (ie. income statement, balance sheet, and capital account) provide a flexible and proven framework for developing the value account. The value account presents the estate's net income, total net worth, and the distribution of assets, which is relevant data for assessing economic sustainability and management performance.

The fundamental difference between the value account and the physical account is that a wide range of estate elements are expressed in common monetary values. Thus, where it is possible to draw very sharp distinctions from the physical account, the contrasts may not be so apparent in the value account. For example, timber harvest is a physical reduction in the standing inventory in the physical accounts. Whereas in the value account, the value of one asset class (timber) is reduced while the value of another (cash, from the sale of logs) is increased. In the latter case, the composition of the asset base has changed, while it might be the case that the total value of the asset base is unchanged. In the value account, concerns over maintaining the capital base (which were discussed earlier) are more broadly viewed as maintaining the asset base.

In recent years, concerns have been expressed with regards to the methods used to prepare a company's as well as a nation's financial accounts. The concern is that the methods are providing inaccurate measures of wealth and income because the consumption of scarce, non-priced environmental resources (clean air, water and soil for example) and the depletion of natural resources are either not included, or inadequately included in the accounts (Repetto, 1989), (Hamilton, 1989). Since the national and provincial accounts are used to make economic policy decisions, this bias (it is argued) may lead to incorrect policy prescriptions and promote environmental degradation.

This chapter attempts to clarify the implications of some of these general concerns with respect to the proper accounting of the forest estate. Presently, there is no reconciled system of accounts of the crown's forest showing income and changes in wealth. Consequently, questions as to the asset value of the standing forest inventory, or what is the depreciation of natural resource asset base, among others, are not addressed. Furthermore, this chapter

attempts to identify methods that provide indicators of the true status of the forest estate, not just answers. This challenge is only partially met here, since even within the accounting profession an unsettled question is the proper valuation of assets (market value or historic cost[4]). This then is an initial effort to identify some of the difficulties and to propose a general approach to developing the estate's value accounts, rather than the final answer.

Before presenting an illustration of the estate value accounts several key issues are discussed. These are:

- The meaning of sustainability in the value accounts;
- Valuation of the estate's natural resource assets;
- Appropriate value measures of natural resources depletion.

4.2.1 INDICATOR OF SUSTAINABILITY

Since the publication of "Our Common Future" by the U.N. World Commission on Environment and Development (WCED) in 1987, the concept of sustainable development has been embraced by many jurisdictions as a central planning ethic, Canada and British Columbia included (National Task Force on Environment and Economy (1987): B.C. Task Force on Environment and Economy (1989)). The guiding principle of this planning ethic is generalized as "... development that meets the needs of the present without compromising the ability of future generations to meet their needs."

Much earlier, Sir John Hicks viewed income in terms of a sustainable level of consumption:

> "The purpose of income calculations in practical affairs is to give people an indication of the amount which they can consume without impoverishing themselves. Following out this idea, it would seem that we ought to define a man's income as the maximum value which he can consume in a week, and still

4. See for example "Stricter rules for valuation proposed", the Globe and Mail 21/12/90. The article reports that the chief rule making body of the U.S. accounting industry has agreed to propose that companies give shareholders more up-to-date information about their market value. Also "Assets should be Marked to Market" Fortune, January 14, 1991; page 58. Article notes that the U.S. Securities and Exchange Commission may require corporations to report assets at market value rather historic cost accounting, and the controversy the proposal is causing.

> expect to be as well off at the end of the week as he was at the beginning." (Hicks, 1946)

The income of the forest estate is determined on the income statement of the value accounts. Assuming for the moment that all receipts, expenditures, and capital consumption values are correct (ie. reflect full economic values), the income statement may indicate zero, negative, or positive net income for the period.

A zero net income indicates that the total revenue of the estate's outputs is equal to the aggregate costs of all inputs (materials, labour, capital, and land) used in the production process. The Estate's balance sheet would indicate that the asset base remained fully intact[5].

A negative net income arises when the value of Estate's outputs is less than the value of labour, materials, and capital used up in production. The estate's balance sheet in this case will indicate a decline in the Estate's asset base[6]. Negative income is not tenable over the long term since eventually the asset base would be exhausted.

A positive net income indicates a surplus after accounting for the consumption of all resources in the production process. It implies that the Estate's asset base is fully intact and future levels of income can be sustained. (Whether the surplus can be maintained depends on the nature of the factors giving rise to the surplus. If, for example the surplus arises from higher productivity of the land relative to other lands, then the surplus would continue as long as this advantage was maintained.)

In sum, given that the appropriate valuation criteria has been incorporated, a properly prepared income statement should provide a reliable indicator of whether the asset base of the forest estate was drawn down, or left intact during the period under study.

---

5. The notional payment to capital in this discussion is the minimum necessary to maintain capital's productive capacity. It does not include economic profit, premium for risk, etc. which is crucial in economic terms to determine the allocation of capital across the economy.

6. The income statement presents the flow of activity over a period while the balance sheet presents the stock of assets, liabilities and net worth (assets minus liabilities) at a specific moment. A fundamental accounting identity that links the income statement and balance sheet is that net income during the period equals the change in net worth between the opening and closing balance sheets.

In practice, the value account will reflect short term temporary fluctuations as well as longer term permanent trends. Care will be required in interpreting the account in assessing implications to long term sustainability.

4.2.2 VALUATION

The objectivity and ultimate usefulness of the value accounts hinge to a large extent on the impartial valuation of the of the assets, liabilities, outputs and resources consumed in production from the forest estate. For most of these elements, market prices exist. These often represent the most objective measure of society's relative valuation.

There are however a number of important elements (assets, liabilities, inputs and production) of the forest estate where market prices do not exist.

In some cases market prices do not exist because of existing conventions ie. recreation opportunities are supplied free of charge. In principle, persons could be charge for access to the recreational opportunities. If this was done the revenue received would be included in the accounts. But if recreationists were not charged, it would be speculative to include a value in the accounts representing a sum that would have been paid if a charge had been levied, or some other measure of the user's imputed valuation of the recreation opportunity as discussed in **Appendix III**.

There are also outputs for which, that by their nature, no market can exist i.e. preservation values, visual amenities. Finally, the Estate may "consume" environmental resources (clean water, clean air, etc.) which imposes costs on others. Whereas such costs can at least be estimated in an objective manner, there is often no market for those incurring the cost to charge the estate for the consumption of the resources.

In order to maintain the greatest degree of impartiality in the value accounts, two approaches are open to deal with these "difficult-to-quantify" resources. For those resources where market values can be imputed with a sufficient level of confidence, this information could be contained in subsidiary or satellite accounts. For other elements where a market valuation is not practical, a qualitative assessment should be provided in the body of the report. These proposals are not intended to denigrate the importance of these elements in managing the forest estate, but to clearly recognize the more speculative nature of the values concerned.

The intent is to provide an estate report that objectively portrays the important qualitative and quantitative features of the forest estate.

In developing the appropriate values to be used in the subsidiary accounts a great deal of estate specific work is required (which was not undertaken in this pilot study). **It is not appropriate that provincial "averages" be used as proxies for estate values**. To present an accurate position in the account as well as providing key management information, efforts must focus on deriving values appropriate to the characteristics and circumstances of the particular estate.

With respect to manmade capital, the asset and capital consumption values presented in the estate's capital account and balance sheet should register as close as practical existing market values rather than historic costs or other accounting conventions that do not relate to actual market values.

With respect to natural resource capital, the standing forest will typically be the dominant asset on the balance sheet and contribute the preponderance of activity on the income statement. There are some particular challenges that must be addressed in accurately reflecting the value of this resource in the value account.

First, it is evident that standing timber has a number of potential uses and generates a variety of societal values that are different in nature. The individual tree has commercial value if harvested. However, the forest may provide an ambience for recreational activities that users are willing to pay to experience, as well as essentially non-economic values such as supporting a variety of life forms. As noted above, unless values can be objectively determined, consideration should be expressed in a satellite account or in qualitative terms. Consequently, the standing timber or forest providing non-commercial values and reserved for such use, must be clearly identified and included in the appropriate satellite account. Otherwise, the financial position of the estate would be misrepresented if standing timber allocated to non-harvest uses was valued at commercial values.

Second, even the value of the forest estate dedicated to commercial fibre production (ie the standing inventory) is, in the absence of an actual arms length sale, difficult to accurately portray.

One approach is to value the standing inventory as the average net product price (revenue less harvesting, hauling and handling costs) multiplied by the physical inventory (Repetto, 1989). This is termed the "conventional inventory method". Using this method the value of the standing inventory in this study is estimated at $103 million. However, imbedded in this approach is the invalid assumption that the forest estate can be rapidly liquidated. Whereas this assumption is generally valid for most manufacturing enterprises (where it is applied for valuing inventories), it is clearly not valid for the forest estate. The forest estate may be legally constrained (by a mandated annual cut and harvest specifications) as well as physically constrained (the timber is not presently accessible) and these constraints effect the value of the estate. For example, on day 1, from the same standing inventory, one could harvest from 105 000 m^3 (option 1) to 133 000 m^3 (option 4) annually, the difference being the silviculture regime. Using the conventional inventory method, the value of the standing timber would be the same given either option, while the market price for the stand given the two management options would be quite different.

An alternative approach for valuing the standing timber inventory is to capitalized the value of the net revenue stream of future harvests at current period prices. This is termed here the "capital valuation method". One need only fix the interest rate and time period to derive a value. For example, given a 5% interest rate, the value of the standing inventory using the capital valuation method was computed at $39 million[7]. This method is a better approximation of the market value of the standing inventory because it acknowledges harvesting constraints and reflects the effects of time in valuing capital assets.

Over time, the value of the standing inventory will change due to changing market prices, harvesting costs, species mix, and the like. The asset value of the standing inventory will rise and fall as a result of these factors. An adjustment will be necessary in the accounts to reconcile these unrealized capital gains and losses. The conventional inventory method will be more sensitive to these factors.

Many of the issues discussed above with respect to the commercial forest inventory are relevant to other populations (wildlife, fish) and the land base. For the purposes of the value account, it is important that the inventory values are represented in a matter that does not detract from the usefulness of the accounts. Otherwise, one should look to the physical account for resource management data.

7. A 5% interest rate is used here for illustrative purposes only.

In summary, how well the value account accurately portrays the position of the estate is a direct function of how well the values assigned to assets and liabilities, production and expenditures reflect current realities. We have suggested here a construction whereby the core accounts (balance sheet,income statement, and capital account) would consist of market or "near market" values (an exception is discussed below). A system of satellite accounts is proposed to present the status of the estate's assets or outputs where valuations are more speculative. For those estate elements where no reliable market valuation is available, a qualitative discussion in the "estate report" is recommended. The development of satellite accounts and the qualitative treatment of the other resources will be difficult. We have not attempted to address the difficulties here. Nevertheless, objective reporting of these values is important as it supports a fuller picture of the forest estate.

4.2.3 NATURAL RESOURCE CONSUMPTION

In the earlier discussion of sustainability, it was noted that the estate's income statement would in principle indicate whether the current level of income is sustainable, provided the elements of the income statement were properly measured. One of these elements is the proper measurement of the natural resource capital consumed during the income production process. It was noted that if income is not reduced to reflect this consumption of natural resource capital then i). the estimate of current income is overstated and ii). current consumption is unsustainable over the longer term because the underlying capital base is being liquidated.

In this section two issues are addressed. The first issue is to define the value of capital depletion (if any) relevant to production from a renewable resource. The second issue is how to properly incorporate the depletion in the value accounts.

a) Capital Depletion; Many of the estate's natural resources managed under a forest management agreement are living, or renewable resources. These include the wildlife and fish resources, the forest, and range lands. Appropriately managed, these resource will continue to generate income perpetually. In this instance there is no capital depletion provided the income from harvests can be sustained forever. No adjustment is required in the accounts as no depletion of the resource base occurs.

However, if a renewable resource is being harvested beyond its regenerative capacity then an adjustment in total receipts is required. In particular, for most of the management scenarios the old growth component of the forest is being replaced by a managed second growth stand[8]. In the context of the value accounts the liquidation of the old growth would not be significant if the regenerated forest was of equal value (in commercial terms). For example, the net value of old growth lodgepole pine in this forest estate is about the same as that of the net value from the second growth. In this case, no resource depletion value would be attached to the liquidation of the old growth lodgepole pine.

On the other hand, the higher volume stems of the old growth Douglas-fir command a premium above the price fetched by the lower volume second growth Douglas-fir stems to follow. With respect to the forest estate, it was found that the net value of old growth Douglas fir averaged $\$24.70/m^3$ compared to a second growth average value of $\$11.86/m^3$. The value of the second growth forest is the sustainable income (i.e $\$11.86/m^3$), whereas the "old growth premium" of $12.84 (ie. 24.70-11.86) is a one time only bonus. That is, this premium, or a portion thereof, should be recognized as capital depletion and represented in the accounts.

b) Resource Depletion in the Value Accounts; One objective of the value account is to indicate sustainable income. Clearly, it would be incorrect to include all of the old growth premium identified above (and income of this nature) as income. On the other hand it seems incorrect to exclude all of the premium from income. In terms of defining a sustainable level of income, what is sought is a method that converts this "one time premium" into an equivalent perpetual income stream. Of the several methods presently being discussed, the approach proposed by El Serafy (1989) is adapted here as it is consistent with the general principle of sustainable income and relatively straightforward in application[9].

8. Although technically an old growth forest is reproducible, it was discussed in Chapter 2 that it may not be the most attractive forest or land management alternative.

9. In many respects a conceptual framework for addressing this question was presented in 1931 by H. Hotelling in "The Economics of Exhaustible Resources".

To illustrate this approach, consider the wealth and income position of an estate owner who, in this simple example, is harvesting an estate of old growth Douglas fir. Further assume that he reseeds the land in salt so no future crop will grow. Revenue (after deducting harvesting costs) from the sale of the logs is no more than converting from one asset; standing inventory; to another, cash. If he consumes all his net receipts in every period, then his consumption falls to zero when the forest is fully harvested. In other words, he has converted his forest asset into a cash asset, and then consumed all of his asset base. His consumption level was not sustainable in the sense that his assets were less at the end of a year (or week) than at the beginning, and clearly not sustainable over the long term. Alternatively, the owner could deposit a portion of current receipts in a savings account, thereby preserving a portion of his cash asset base, which in the future would generate a flow of interest income making up for the eventual loss of income from the trees.

That is, the question is how much must be set aside to convert the wealth of the wasting timber asset into a perpetual income stream (true income in El Serafy terms). The answer is a relatively simple mathematical relationship depending only on the expected life of the asset and the interest rate[10];

$$X/R = 1/(1+r)^n$$

where:

X is capital consumption or "minimum deposit"

R is total receipts

r is the interest rate

n is the period the resource is to be liquidated[11]

10. There are in fact a number of different investment strategies that ensure future income flow. El Serafy's formulation identifies an extreme investment strategy whereby only the minimum deposit is made that will maintain a maximum uniform consumption level in perpetuity. This pattern more nearly fits the definition of sustainable income (i.e. maximum amount you can consume over time without making yourself worse off). If one is not setting aside at least this amount, then future consumption levels will fall. On the other hand, one could choose to deposit more than this minimum, or even all the net receipts into a savings account to ensure future consumption levels.

11. Whereas we have accepted the logic of Serafy's argument, we did not accept his specific formulation of the ratio of true income to net receipts. In his formulation, the denominator is raised to the power n+1, which implies an additional payment. We found the more intuitively appealing formulation is arrived at by raising the denominator by n.

The formula is used to determine the proportion of current receipts that is depletable capital i.e. the minimum amount that must be set aside to maintain present consumption level into the future.

To continue with the example, given the estate would be liquidated in 50 years and one could earn 5% in a savings account, then a minimum of 9% of net receipts (or 9% of the old growth premium in the context of the forest estate) should be deposited. That is, sustainable income is 91% of net receipts. If the estate were to be harvested in 20 years, then at least 38% of net receipts would need to be deposited. (A Table of the Income and Capital content of receipts at different interest rates and depletion periods is reproduced in **Appendix IV**).

The intention of the value accounts is to indicate the true position of the estate. For this purpose it is not essential that the capital depletion portion identified be actually set aside and reinvested. The owner may do whatever he chooses. However, he should be aware that his sustainable income diverges from his total net receipts. This would be indicated in the accounts.

4.3 ILLUSTRATION OF VALUE ACCOUNT

The purpose of this section is to show how the estate value account might be constructed and to illustrate, using values derived from one of the management scenarios, how some of the issues discussed earlier might be addressed. Hence, the account is less detailed, with relatively greater focus on the timber resource, than might be the case of an actual value account. Furthermore, FIBRPLAN III is an estate model whereas the data necessary to compile much of the data required in the value account is stand specific. That is, the magnitude of the values used in the illustration are derived from estate aggregate values and likely represent the appropriate magnitude, but they are approximate values only.

The value account is composed of three related financial statements; the capital account, the income statement, and the balance sheet. The capital account summarizes the opening and closing balance of capital assets, and the value of capital depreciation during the year. Important elements of the capital account is the timber inventory, and the depletion of old growth (if any) during the year. The income statement measures the estate's net income realized during the year. This is the total value of receipts less operating and capital charges

TABLE 4.2

CAPITAL ACCOUNTS

(Year 1)

	Open	Change	Close
Fixed Assets	$10,000	$500	$9,500
Land	$7,396	$0	$7,396
Standing Inventory	$38,740	$770	$37,970
Old growth depletion		$439	
Market adjustment		$331	
Total	**$56,136**		**$54,866**

(Year 2)

	Open	Change	Close
Fixed Assets	$9,500	$500	$9,000
Land	$7,396	$0	$7,396
Standing Inventory	$37,970	$795	$37,175
Old growth depletion		$439	
Market adjustment		$356	
Total	**$54,866**		**$53,571**

(from the capital account). The balance sheet is a snapshot of the estate's total wealth at a specific point in time. Total wealth is total assets less liabilities and is termed in the balance sheet shareholder's equity.

4.3.1 CAPITAL ACCOUNT

The estate capital account for years 1 and 2 are presented in **Table 4.2**, opposite. The purpose of the account is to summarize the consumption of the estate's capital over the period.

Fixed capital refers to the structures, roads, and the like on the estate. A value of $10 million was chosen to represent this value. A straight-line depreciation rate of 5% (or asset life of 20 years) was assumed. The account would also show the stock and depreciation of machinery and equipment belonging to the estate, but they have been ignored in this instance.

Land is a non-depreciable capital asset. Its value here is intended to reflect the capitalized value of the flow of non-timber services (ie. providing recreation opportunities, wildlife habitat, etc.) This value was taken to be some $200 per hectare over the estate's some 37 000 ha.

The value of the standing inventory was calculated using the "capital valuation method" discussed in 4.2.2. This method values the standing inventory as the capitalized sum of the expected net revenue of future harvests. In the computation, an interest rate of 5% is used as this value is fairly reflective of the rate used to capitalize forest lands. In practice, it is possible to have a reliable estimate of the long term harvest schedule hence the relative volume and value of fibre and corresponding harvesting costs. Applied to this would be the owner's view of long term average log prices. This view may change from time to time and this would be reflected as an adjustment to inventory. In this example, log values as at mid-year 1990 were taken as the long term average. The resulting expected net revenue flow was shown on **Figure 3.6**. The value of the inventory at each point in time was estimated as the net present value of this net revenue flow over a 200-year period. At the beginning of year 1 this value was almost $39 million. During the production period the value declined some $770 thousand due to old growth depletion and other factors.

TABLE 4.3

INCOME STATEMENT

	YEAR 2	YEAR 1
Revenues		
Sale of Timber	$5,059	$5,485
Sale of Range	$5	$5
Campground fees	$2	$2
Total	$5,066	$5,492
Cost and Expenses		
Cost of sales	$2,714	$2,505
Silviculture costs	$387	$0
Costs related to range	$2	$2
Costs related to recreation	$2	$2
Charges from the Capital Account		
Depreciation of fixed assets	$500	$500
Old growth depletion	$439	$439
Market adj. to timber inventory	$356	$331
Total charges from Capital Account	$1,295	$1,270
Net Income (Loss)	**$666**	**$1,713**

The concept of old growth depletion was discussed in 4.3.3. For this estate it was found that the average net value of old growth Douglas fir was $\$24.70/m^3$ compared to the average net value of second growth of $\$11.86/m^3$, for an "old growth premium" of $\$12.84/m^3$. In year 1, the volume of old growth Douglas fir harvested was 90 000 m^3, or a total old growth premium of $1.15 million. As discussed earlier, this premium represents a "one time bonus", and as such it would be inappropriate to record the full amount as income since this level of income cannot be sustained. Instead, an amount should be recognized as a capital depletion charge that might be set aside in an interest bearing capacity. It was noted earlier that the minimum amount that should be set aside depends only on the interest rate and the time period until the resource will be fully exhausted. In this management scenario, the old growth Douglas fir is expected to be fully liquidated within 20 years. Assuming a 5% interest rate, this yields a capital depletion of .38 (**Appendix III**). That is, the old growth depletion is the old growth premium multiplied by the factor, or in year 1 $439,000.

In this management scenario the old growth lodgepole pine is liquidated within 40 years but the subsequent second growth is about of equal value so no "old growth premium" arises.

The computations are presented for two years. Over the period in this illustration the total value of the capital stock has declined due to the consumption of fixed capital, depletion of old growth, and adjustment to the market value of inventory. No new investments in capital stock were assumed in this illustration.

4.3.2 INCOME STATEMENT

The income statement summarizes the flow of Gross Revenues, expenditures, and capital consumption during the period. It was noted in 4.2.1, if all inputs are properly measured the net income derived in this statement should register "sustainable income". Further, if net income were zero or a positive value then the estate's asset base remained intact during the production period.

In this example (**Table 4.3**, opposite), FIBRPLAN III provided estimates of the revenue from the sale of timber, the cost of sales, and silviculture costs. Revenue and costs associated with recreation and range are shown to illustrate how these activities of estate management would be reflected in the statement. Current charges for capital are brought down from the capital account.

TABLE 4.4
BALANCE SHEET

(Year 1)
('000$)

OPEN			
Assets		Liabilities and Owners Equity	
Cash and near cash			
Old Growth Account			
cash	$0	Liabilities	$0
Depletion Account	$0		
Other Cash	$0	Owners Equity	$56,136
Total Cash	$0		
Fixed Assets	$10,000		
Land	$7,396	Total Liabilities	
Timber Inventories	$38,740	and Owners	
Total Assets	$56,136	Equity	$56,136
CLOSE			
Assets		Liabilities and Owners Equity	
Cash and near cash			
Old Growth Account		Liabilities	$0
cash	$676		
Depletion Account	$439	Owners Equity	$57,849
Other Cash	$1,868		
Total Cash	$2,983		
Fixed Assets	$9,500		
Land	$7,396	Total Liabilities	
Timber Inventories	$37,970	and Owners	
Total Assets	$57,849	Equity	$57,849

(Year 2)
('000$)

OPEN			
Assets		Liabilities and Owners Equity	
Cash and near cash			
Old Growth Account			
cash	$676	Liabilities	$0
Depletion Account	$439		
Other Cash	$1,868	Owners Equity	$57,849
Total Cash	$2,983		
Fixed Assets	$9,500		
Land	$7,396	Total Liabilities	
Timber Inventories	$37,970	and Owners	
Total Assets	$57,849	Equity	$57,849
CLOSE			
Assets		Liabilities and Owners Equity	
Cash and near cash			
Old Growth Account		Liabilities	$0
cash	$1,352		
Depletion Account	$878	Owners Equity	$58,515
Other Cash	$2,714		
Total Cash	$4,944		
Fixed Assets	$9,000		
Land	$7,396	Total Liabilities	
Timber Inventories	$37,175	and Owners	
Total Assets	$58,515	Equity	$58,515

Total revenue less total costs derives the net income. In both years income is positive. It declines markedly in year two because of lower revenues from timber sales, higher harvesting costs and silviculture costs which were not incurred in year one. Since prices are assumed to be constant, this variation in net income derives largely from the differential among sites as to value of fibre and harvesting costs.

Over the long term, the "old growth depletion factor" will decline to zero as the this element of the estate is fully harvested. During this period, the net income presented in the income statement will be less than the net revenue projection in **Figure 3.6**, but will closely track it thereafter. From this one could conclude that the capital base of the estate is being sustained. This is also shown on the estate balance sheet.

4.3.3 BALANCE SHEET

The balance sheet summarizes the estate's stock of assets and liabilities at the end of each production period is shown on **Table 4.4**, opposite. Assets minus liabilities is a measure of the estate's wealth or shareholder's equity (or market value if all assets and liabilities are valued at current market prices).

Of the estate assets, most have already been discussed in the context of the other accounts. An exception is the cash asset. In this illustration one asset (trees) are being converted to another asset, cash. In reality some of this cash may be distributed to the shareholders as dividends, but in this illustration all cash generated is retained.

Within the cash account, we have identified the entire "old growth premium" within an old growth account as cash and a "depletion account". The cash in the depletion account represents the accumulated balance of the minimum amount that must be set aside to ensure a sustainable level of income when the old growth is gone. The remaining "old growth" cash may also be set aside to provide for future income if the estate owner so chooses. The "other cash" is revenue that derives from harvesting the old growth that is not part of the "old growth premium" and cash from other sources.

A comparison of the balance sheets over the two periods shows that the shareholder's equity (i.e. wealth) is increasing. From the capital statement we found that the value of the capital assets declined. However, this is was more than offset by the growth in another asset, cash.

It might be noted that if we had used the "standard inventory" approach to valuing the standing inventory, the estate's wealth position as represented on the balance sheet would be some $60 million higher (ie. $100 million for the value of the standing inventory verses some $40 million used here). Whereas the approach chosen for valuing the standing inventory markedly effects the opening wealth position of the estate, changes from this position are determined from the income statement.

5.0 REFERENCES

Environmental Accounting for Sustainable Development. 1985. (Ed.) Jusuf Ahmad, Salah El Sercfy, Ernst Lutz. UNEP - World Bank Symposium

Hamilton, Kirk. Natural Resources and National Wealth. Statistics Canada. July 1989.

Hicks, J.R. 1946. Value and Capital. 2nd edition. Oxford University Press.

National Task Force on Environment and Economy. 1987. Report. Submitted to the Canadian Council of Resource and Environment Ministers. Ottawa.

Repetto, Robert et al. Wasting Assets, Natural Resources in National Accounts, World Resource Institute. June 1989.

World Commission on Environment and Development. 1987. Our Common Future. Oxford University Press, Oxford and New York.

FOREST RESOURCE MANAGEMENT
ALTERNATIVES STUDY

APPENDICES

FORTRENDS Consulting Inc.

A division of T.M. Thomson & Associates Ltd.

APPENDIX I

DEFINITION OF SCENARIOS AND MODELS USED IN THE STUDY

APPENDIX I

INTRODUCTION

Twelve scenarios are presented. These represent a cross-section of the range of management options which appear feasible, given the information and data available. The following paragraphs briefly describe the objectives each scenario is designed to depict and the rationale used in the construction of each scenario.

Scenario Overviews

Run 1. Natural Regeneration Only

This scenario is designed to illustrate the expected fibre flows, sustainable harvest rates and cashflows which would result from a least-cost silviculture program (natural regeneration only). Yield forecasts and natural regeneration chance are based upon past experience in the region. Costs, revenues and harvest utilization standards are based upon mid-1990 prices and MOF logging standards for the region. No brushing, site preparation, weeding, thinning or other silvicultural activities were allowed. The long-run sustained harvest from this natural regeneration scenario is estimated at 105,000 m^3/year.

Run 2. MOF Basic Silviculture

This scenario illustrates the expected results which would accrue from implementing the MOF's basic silviculture program (planting all sites and ensuring that a minimum target stocking level was successfully achieved). Future yields and regeneration activities (site preparation, length of delays prior to planting, stock type planted, etc.) were based on regional experience. Stands were assumed to be planted back to the original species harvested from the site. No other silvicultural activities were allowed. The long-run sustained harvest from this scenario is 115,000 m^3/year, at today's log utilization standards.

Run 3. Selected Silviculture

This scenario depicts the expected results from practising a moderate level of intensive silviculture. The same basic silvicultural activities were utilized with the addition of spacing (to remove unwanted competition) and fertilization of good sites. The specific silvicultural activities included are: prompt planting (with site preparation as needed) on all good and medium sites; natural regeneration on all poor sites; spacing to reduce inter-tree competition and improve crop tree distribution and growth rates on all medium and good sites; and fertilization of all good sites after spacing. This run illustrates what we believe would be a typical, industrial "intensive forest management" program. The long-run sustained yield from this scenario is 133,000 m^3/year, a 30% increase over Run 1.

Run 4. Maximum Fibre Production

This scenario is meant to illustrate the maximum achievable fibre flows on the sample landbase. The same type of silvicultural activities were utilized, however, in this run, they were designed to achieve maximum fibre production. Costs of such treatments was a secondary consideration. Regeneration delays were minimized; all sites were planted; preference was given to those species with the fastest growth rates (lodgepole pine and Douglas-fir); all stands were spaced and all stands were fertilized at least twice, preferably three times.

The average harvest level over the 200-year planning horizon was 174,500 m^3/year, approximately 70% more than what was achievable in Run 1. However, due to the age class structure of the forest on the sample landbase, the full 70% increase couldn't be taken all at once. For the first 100 years, the cut was set at 133,000 m^3/year. The cut was raised to 205,000 m^3/year for the next 20 years and then raised to 220,000/year for the remaining 80 years of the simulation.

Runs 5-7. Courser Utilization Standards

These three runs are identical to Runs 1-3 but with the minimum utilization standards raised to 27.5 cm dbh. The effect is to concentrate harvesting on larger, more profitable trees. Obviously, less volume can be harvested over the long term since the average tree must be

grown to a larger size which takes more time. In addition, on some of the poorer sites the stands never achieve an average tree size of 27.5 cm+; thus these sites are never logged.

The results show that making this change effectively reduces the long-term sustainable harvest rate by close to 50% as compared to Runs 1,2 and 3, but profitability is improved due to higher profit margin on the larger trees. In effect these results give one indication of the costs of subsidizing cleaner logging.

Run 8. Long Rotation (Old Growth Rotation Ages)

This run was made to illustrate the effects of managing the forest using rotation ages which result in future stands which are similar to today's old growth stands. The rotation ages used ranged from 150-200 years. The basic effect is a reduction in the average long-term harvest to 87,900 m^3/year.

Run 9. Shelterwood Harvest on Run 2

This scenario was designed to simulate the effects of implementing a limited form of selection logging. In this scenario, mature stands were selectively logged in a shelterwood approach with 70% of the standing volume removed in the first pass, and the remaining 30% removed 20 years later. While this isn't a true selection harvest, the results do provide an indication of selection harvest effects on activities and cashflows.

Run 10. Shelterwood harvest on Run 3

This scenario is similar to Run 9.

Run 11. Recreation Areas Buffered and Wilderness Area Removed from Run 2

This scenario is an attempt to simulate the effects of creating recreation/aesthetic leave strips along the major roads, along the major streams and around lakes. In addition, one area of proposed wilderness was removed from the landbase. The net effect was a reduction of the

average harvest to 95,000 m^3 for the first 150 years with a raise to 110,000 m^3 for the last 50 years.

Run 12. Wildlife Winter Range Areas Removed from Run 2

This scenario illustrates the effects of removing those timbered areas which are prime winter range habitat from the active commercial landbase. In this particular case, the effects are significant in that the allowable harvest is reduced from 133,000 m^3 to 90,000 m^3 for the first 100 years and then can be raised to 105,000 m^3 for the second 100 years. The reason the winter range effect is of such significance is due to the fact that the desired winter range habitat is primarily good and medium site Douglas-fir which has relatively high productivity rates within this estate. As a result, the effect of the removal is significant.

Run 13. Intensive Silviculture to Replace Effects of Run 11

This scenario is an attempt to determine what might be needed in the form of increased silvicultural activities in order to ameliorate the effects of the recreation/aesthetic buffers and the wilderness removal from the commercial forest landbase. Technically it appears feasible to improve yields sufficiently to replace these effects, however we believe that operationally it would be very difficult to do so. For example, to achieve the same long-run harvest level as was determined in Run 2, it is necessary to implement the silvicultural program defined in Run 4 above, (maximum fibre production) plus all stands would have to be commercially thinned. We do not believe that this is operationally feasible, and almost certainly is not economically efficient by today's business standards.

Given all of the above silvicultural practices, a long-run cut of 115,000 appears sustainable.

Run 14 Intensive Silviculture to Replace Winter Range

Due to the nature of the types of high-productivity stands which are favoured for winter range, it is not possible to totally offset the loss of fibre with increased silviculture practices. Even including all activities of Run 4 above and commercially thinning all stands, a shortfall in the annual harvest of about 20,000 m^3/year occurs for a period of at least 20 years starting

in 2030. Given this landbase, it appears that this removal cannot be replaced by increased silvicultural activities alone.

Summary of Scenarios

As can be seen, the scenarios provide a cross-section of available opportunities. All of the scenarios presented area actually the end result of a series of runs made within the definitions of each proposed management option. These scenarios are not meet, nor should they be construed, to be the final word on any of the options. They are only meant to be informative about the sensitivity of this landbase to the management options analyzed. Detailed descriptions of the individual runs follow.

THE YIELD ANALYSIS MODELS USED IN THE STUDY

Two models were used in the yield analysis work done for the study. The first model, a stand growth model, Stand Projection System (SPS), was used to forecast the growth patterns and resulting yields at various ages of the stand's development. These forecasts are done on a per hectare basis. SPS is the most widely used stand growth model in the Pacific Northwest. The models characteristics make it unique and very well suited for the needs of this study.

The second model, a forest estate model, FIBRPLAN, was used to simulate harvest/grow patterns of particular management regimes. The model does this by attaching the stand level growth and yield results to the land base characteristics of the estate, initializing a number of parameters specific to a particular management strategy and then simulating the outcome of a predetermined harvest rate. A reiterative process is then conducted to find a harvest rate that meets the objectives of the estate. The harvest objectives for this study were to find non-declining harvest rates that would be considered operationally feasible.

The FIBRPLAN model's abilities for handling a wide variety of inputs, simulation opportunities and output functions, including linking to GIS made it uniquely suited for this study.

Eight stand level yield tables were developed for this study and processed through over 100 forest estate simulations. Twelve of these forest estate simulations are discussed in the report. A brief description of the yield tables, estate simulations and the assumptions that went into them follows.

Description of the Eight Basic Yield Tables

Yield functions used in this study represent four different intensities of silvicultural management strategy and two different utilization standards for each of these four strategies.

Each of the four strategies is defined by four species:

- Douglas-fir,
- Englemann Spruce,
- Subalpine Fir and
- Lodgepole Pine.

Each of the four species is defined by three site classes;

- good,
- medium and
- poor.

There are a number of initializing criteria used to develop the yield tables for each species and site within each management regime. These are briefly described as follows:

Site Index

The growth and yield of each of the species/site class analysis unit used in the estate modelling is defined by a yield curve developed at the stand level. The site index used in the SPS model to define the site class for the analysis unit were the weighted average site index of each stand contained within the species/site class group. Low sites that were within the net operable land base were grouped with the poor sites for this study. The site indices, base 50 years BHA used to describe each site class is as follows:

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	22	19	20	17
Medium	17	15	18	15
Poor	12	8	12	8

Site occupancy

SPS allows the user to define what percentage of the hectare being modelled will be occupied by tree growth. The site occupancies used for this study are summarized as follows:

- naturally regenerated stands have a 65% site occupancy
- planted stands have a 75% site occupancy
- planted and spaced stands have an 85% site occupancy

Utilization Standards

Both total volume growth and merchantable volume growth are simulated in SPS. Merchantable volume growth is defined by the user for stump height, log length, top diameter and breast height diameter.

The first four yield tables representing differing levels of effort in silvicultural management used the following definitions for merchantability;

- stump height - 30 cm
- log length - 4 meters
- top diameter - 10 cm
- B.H. diameter- 17.5 cm for all species but pine
  - 12.5 cm for lodgepole pine.

The second set of four yield tables used the same silvicultural management assumptions but modified the utilization limits to reflect merchantability of larger logs only. The same

parameters for initializing the model were used with the exception that the B.H. diameter was increased to 27.5 cm for all species.

Natural Fill-in of Planted Stands

All planted stands had a component of natural fill-in regeneration added to the initial planting density. This fill-in was added with a six year delay, a natural distribution and a 40% standard deviation of initial diameters. The density of the fill-in was held constant at 300 stems per hectare. The fill-in species was as follows:

- lodgepole Pine - lodgepole pine
  Douglas-fir
- englemann spruce - englemann spruce
  subalpine fir

Initial Densities of Management Scenarios

Each of the four different management scenarios have a different set of initial densities simulated in producing their yield table. These differences are summarized in the next section along with a brief description of the management strategy.

Description of Stand Level Management Scenarios

Natural Regeneration

This set of yields were developed to allow analyses management strategies where all harvested areas are regenerated by natural processes only.

The initializing criteria for these tables are those discussed above with initial densities by species and site defined here. The number of trees anticipated to be found on the species/site class combination areas after the regeneration delay are represented as follows:

TABLE 1

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	1000	1200	3500	1200
Medium	1000	1200	3500	1200
Poor	1000	2000	3500	2000

Ministry of Forests Basic Silviculture Standards

This set of yield tables were developed to analyze the impacts of regenerating all harvested areas to the Ministry of Forests current target standards for the "basic silviculture regulations". Current legislation requires that all harvested areas in this region of the Province are to be managed to meet or exceed these standards

The planting densities used to initialize these runs are described below. There were no other treatments applied to the stands.

TABLE 2

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	1000	1200	1400	1200
Medium	1000	1200	1400	1200
Poor	1000	1200	1400	1200

Selective Silviculture

This set of yield tables were developed to look at the effects of selecting particular silvicultural activities to analyze their effects on possible harvest opportunities.

In these tables no activity except natural regeneration happens on any of the sites classified as poor.

Spacing activity took place on all medium and good sites at age 20. Fertilization was done on only the good sites at ages 35 and 50. Each fertilization was done at a rate of 250 kilograms per hectare.

The planting densities used to initialize these runs were as follows:

TABLE 3

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	1200	1200	1400	1200
Medium	1200	1200	1400	1200
Poor	1200	1200	1400	1200

"Maximum" Mean Annual Increment

This management scenario was developed to allow analysis of the effects of "maximizing" fibre production on the estate.

Spacing activity took place on all sites at age 20. Fertilization was done on all sites at ages 22, 35 and 50. Each fertilization was done at a rate of 250 kilograms per hectare.

The planting densities used to initialize these runs were as follows:

TABLE 4

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	2000	1200	2000	2500
Medium	2500	1500	2500	3500
Poor	3000	1200	3000	1200

Tables 5 to 8 Modified Utilization Standards

The same four scenarios were re-run with the only difference being the utilization standards for the minimum diameter at breast height. In the previous runs all utilization standards for breast height were set at 17.5 cm for Douglas-fir, Spruce, Subalpine Fir and 12.5 cm for lodgepole pine.

In scenarios 5 to 8, the minimum diameter at breast height was changed to 27.5 cm for all species.

Description of Forest Estate Runs

A large number of items are initialized for a yield analysis on a forest estate. The initializing criteria that are common to all runs are described here. The "customized" criteria for individual runs are presented in the description of that run.

Species Group Combinations

The same species group definitions were used in the estate model as were used in the stand model;

- Douglas-fir
- Lodgepole Pine
- Englemann Spruce
- Subalpine Fir

All species identified in the inventory were appropriately assigned to one of these species groups.

Site Class Definitions

The inventory was assigned site class definitions by the following criteria:

Site Class	Site Index Range
Poor	0 to 12
Medium	13 to 18
Good	19 to 45

Merchantability Definitions and Assignments

Merchantability was assigned the same way it was assigned in the stand yield projections

Maturity Criteria

Maturity criteria changed with each run and will be defined in the run description

Regeneration Delays

Regeneration delays changed with each run and will be defined in the run description.

Management regimes and Allocation of Regimes

Management regimes and the allocation of those regimes changed with each run and will be defined in the run description.

Harvest Level

Harvest levels changed with each run and will be defined in the run description. Harvest levels were always non-declining, in some cases harvest levels were increased at points throughout the planning horizon.

Harvest levels were established so that there would always be at least 10 times the operable, available wood as the planned harvest in any one year. This was an attempt to ensure that the harvest level was not only technically feasible but also would likely be operationally feasible.

Wood Type Priority

Wood types were defined as old growth, second growth and thinning. The priority for harvesting was held constant in this same order.

Species Harvest Priority

Species harvest priority was held constant with priority given to Douglas-fir, lodgepole pine, englemann spruce and subalpine fir

Limits of Harvest by Wood Type

There were no limits of the prescribed harvest level placed on any of the wood types. The harvest level was achieved from wherever the wood was available.

Limits of Harvest by Species Type

Limits of harvest by species type were defined to approximate the profile of the current inventory and the ability of the sites to support specific species.

Treatment Costs by Regime

Treatment costs varied by the intensity of the treatment for each run. They will be defined for each run description.

Harvest Costs

Harvest costs were constant throughout all the runs. The impacts on harvest cost are mostly effected by the equipment used, the terrain and the haul distance. The simplest surrogate of these factors was determined to be site class. Harvest costs were then held constant at $27.00/m^3$ on good sites, $22.00/m^3$ on medium sites and $21.00/m^3$ on poor sites.

Harvest Revenues

Harvest revenues were defined by species and diameter class for all runs as follows;

	DIAMETER CLASS				
	12-14	15-16	17-18	19-20	21-22
BL	26.15	27.00	29.40	31.80	34.30
DF	28.75	29.25	31.50	34.00	36.85
PL	23.00	23.50	25.50	27.75	30.25
SE	26.90	27.75	30.15	32.60	35.10
	23-24	25-26	27-28	29-30	31-32
BL	36.45	38.60	40.50	42.95	45.60
DF	39.00	41.25	43.70	46.15	48.00
PL	32.25	34.35	36.65	40.00	41.50
SE	37.30	39.40	41.35	43.80	46.50

	33-34	35-36	37-38	39-40	41-42
BL	48.10	50.65	52.35	53.35	53.35
DF	49.65	51.40	52.90	53.80	54.50
PL	42.00	42.00	42.00	42.00	42.00
SE	49.00	51.60	53.30	53.30	53.30

	43-44	45-46	47-48	49-50	51-999
BL	53.35	53.35	53.35	53.35	53.35
DF	55.15	55.85	56.50	57.20	57.20
PL	42.00	42.00	42.00	42.00	42.00
SE	54.30	54.30	54.30	54.30	54.30

Processing and Reporting

FIBRPLAN processes on an annual cycle. Reports can be generated over any user specified interval. All reports for all runs in this study were reported on a 10 year interval.

State of the Forest Reports were generated every 20 years throughout the 200 year planning horizon.

Administration Costs

The model can assign fixed administration costs and variable administration costs. For all runs in this study the fixed cost was set at $8.00 per hectare, the variable costs were set at $5.00 per hectare. The variable costs are assigned each year to any hectare harvested or silviculturally treated.

DEFINITION OF THE INDIVIDUAL RUNS

Run 1. Natural Regeneration

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing a strategy of natural regeneration management of the forest. The natural stand yield functions for each species and site used in the analysis has been defined above.

A harvest level of 105,000 m^3 per year is sustainable over the 200 year planning horizon simulated. This level is very close to the calculated long-run sustained yield

Regeneration Delays

The period of time between harvest and when the anticipated initial stocking levels are reached is termed regeneration delay. The regeneration delays used in this management strategy are as follows:

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	8	8	6	10
Medium	10	10	8	15
Poor	12	12	10	20

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	140	120	110
Douglas-fir	110	90	80
Lodgepole Pine	90	80	70
Englemann Spruce	110	90	80

Run 2. MOF Basic Silviculture

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing the Ministry of Forests regulated "basic silviculture" management strategy for forest. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

A harvest level of 115,000 m^3 per year is sustainable over the 200 year planning horizon simulated. This level is very close to the calculated long-run sustained yield

Management Regimes and Allocations

100 per cent of all sites were planted back to their original species to the target stocking level required by the Ministry of Forest's Basic Silviculture Regulation

Regeneration Delays

The period of time between harvest and when the anticipated initial stocking levels are reached is termed regeneration delay. The regeneration delays used in this management strategy are as follows:

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	4	4	4	4
Medium	6	6	6	6
Poor	8	8	8	8

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	140	120	110
Douglas-fir	110	90	80
Lodgepole Pine	90	80	70
Englemann Spruce	110	90	80

Treatment Costs

Outside of harvesting, planting was the only treatment cost analyzed. These costs reflect some site preparation activity and the varying planting densities.

The planting treatment costs used in this run are as follows:

SPECIES	COST PER HECTARE
Subalpine Fir	$850
Douglas-fir	$750
Lodgepole Pine	$950
Englemann Spruce	$850

Run 3. Selective Silviculture

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing a strategy reflecting a selective silvicultural treatments. The silvicultural treatments were selected as ones that may allow a reasonable quantity/quality return to harvest from the investment. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

An average harvest level of 131,500 m^3 per year is sustainable over the 200 year planning horizon simulated. This level is achieved by an initial harvest level of 120,000 m^3 for the first 100 years, then 135,000 m^3 for the next 30 years and finally 150,000 m^3 for the remainder of the planning horizon. This average level is very close to the calculated long-run sustained yield.

Management Regimes and Allocations

All areas classified as poor site were naturally regenerated after harvest. No other activity took place on these sites.

All sites classified as medium and good were spaced to maintain initial stocking levels at age 20 years. All good sites were fertilized at ages 35 and 50 years with 250 kilograms per hectare.

Regeneration Delays

The period of time between harvest and when the anticipated initial stocking levels are reached is termed regeneration delay. The regeneration delays used in this management strategy are as follows:

	SPECIES			
	Doug-fir	E. Spruce	L. Pine	Subalp. Fir
SITE CLASS				
Good	2	2	2	2
Medium	2	2	2	2
Poor	12	12	10	20

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	140	120	110
Douglas-fir	110	90	80
Lodgepole Pine	90	80	70
Englemann Spruce	110	90	80

Treatment Costs

SPECIES	COST PER HECTARE		
	Plant	Space	Fertilize
Subalpine Fir	$850	$400	$150
Douglas-fir	$850	$400	$150
Lodgepole Pine	$950	$400	$150
Englemann Spruce	$850	$400	$150

Run 4. "Maximize" Mean Annual Increment

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing a strategy that would approximate the maximum biological potential of the estate. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

An average harvest level of 174,500 m^3 per year is sustainable over the 200 year planning horizon simulated. This level is achieved by an initial harvest level of 133,000 m^3 for the first 100 years, then 2005,000 m^3 for the next 20 years and finally 220,000 m^3 for the remainder of the planning horizon. This average level is very close to the calculated long-run sustained yield.

Management Regimes and Allocations

All sites were planted with an initial density that would maximize the MAI from each species and site classification.

All sites were spaced to maintain initial stocking levels at age 20 years. All sites were fertilized at ages 22, 35 and 50 years with 250 kilograms per hectare.

Regeneration Delays

All sites were planted with a two year regeneration delay.

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	140	100	80
Douglas-fir	90	80	80
Lodgepole Pine	80	60	60
Englemann Spruce	110	80	80

Treatment Costs

	COST PER HECTARE		
SPECIES	Plant	Space	Fertilize
Subalpine Fir	$1500	$400	$150
Douglas-fir	$1500	$400	$150
Lodgepole Pine	$1500	$400	$150
Englemann Spruce	$1050	$400	$150

Run 5. Modified Utilization on Run 1.

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing a natural regeneration strategy with a utilization limit increase to 27.5 cm diameter at breast height for all species. The natural stand yield functions for each species and site used in the analysis for this strategy has been defined above.

A harvest level of 55,000 m^3 per year is sustainable over the 200 year planning horizon simulated. This harvest level is very close to the calculated long-run sustained yield.

Regeneration Delays

The same regeneration delays as run 1. were used.

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	150	150	120
Douglas-fir	120	100	80
Lodgepole Pine	120	110	110
Englemann Spruce	120	110	90

Run 6. Modified Utilization on Run 2.

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing the Ministry of Forests "Basic Silviculture" strategy as in Run 2 with a utilization limit increase to 27.5 cm diameter at breast height for all species. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

A average harvest level of 79,000 m^3 per year is sustainable over the 200 year planning horizon simulated. This average level is attained by harvesting 65,000 m^3 for the first 130 years and then 105,000 m^3 for the remainder of the 200 year horizon. This average is very close to the calculated long-run sustained yield for this strategy.

Regeneration Delays

The same regeneration delays as run 2. were used.

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	150	130	130
Douglas-fir	120	100	90
Lodgepole Pine	120	90	70
Englemann Spruce	120	110	80

Treatment Costs

The same treatment costs used in Run 2 were used in this simulation run.

Run 7. Modified Utilization on Run 3.

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing the same silvicultural management strategy as in Run 3 with a utilization limit increase to 27.5 cm diameter at breast height for all species. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

A average harvest level of 79,500 m^3 per year is sustainable over the 200 year planning horizon simulated. This average level is attained by harvesting 60,000 m^3 for the first 60 years, 80,000 m^3 for the next 80 years and then 100,000 m^3 for the remainder of the 200 year horizon. This average is very close to the calculated long-run sustained yield for this strategy.

Regeneration Delays

The same regeneration delays as run 3. were used.

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	150	130	130
Douglas-fir	120	100	90
Lodgepole Pine	120	90	70
Englemann Spruce	120	110	80

Treatment Costs

The same treatment costs used in Run 3 were used in this simulation run.

Run 8. "Old Growth" Rotation Ages

This yield analysis was done to establish the non-declining sustainable harvest attainable by employing the Ministry of Forests "Basic Silviculture" management strategy as in Run 2 with rotation lengths anticipated to simulate old growth conditions. The managed stand yield functions for each species and site used in the analysis for this strategy has been defined above.

An average harvest level of 87,900 m^3 per year is sustainable over the 200 year planning horizon simulated. This average level is attained by harvesting 80,000 m^3 for the first 100 years, and then 100,000 m^3 for the remainder of the 200 year horizon. This average is very close to the calculated long-run sustained yield for this strategy.

Regeneration Delays

The same regeneration delays as run 2. were used.

Maturity Criteria

The point at which a stand's growth is deemed to be available for harvest can be determined in FIBRPLAN by a specified age, minimum height, minimum diameter, minimum volume or culmination of mean annual increment. For this study a specified age close to culmination was chosen.

The specified ages chosen for this run are as follows:

	SITE CLASS		
	Poor	Medium	Good
SPECIES			
Subalpine Fir	200	175	150
Douglas-fir	200	175	150
Lodgepole Pine	200	175	150
Englemann Spruce	200	175	150

Treatment Costs

The same treatment costs used in Run 2 were used in this simulation run.

Run 9. Shelterwood Harvest on Run 2.

This run was done to simulate the effects of using a form of selection harvest for harvesting mature timber. The same assumptions as used in Run 2, MOF Basic Silviculture, were used in this run. Yield forecasts were changed to reflect the effects of selectively harvesting mature stands.

In this scenario, approximately 70% of a stand was removed in the first pass with the remaining 30% removed in the second pass 20 years later.

In this scenario, approximately 70% of a stand was removed in the first pass with the remaining 30% removed in the second pass 20 years later.

Regeneration Delays

Regeneration delays were changed to reflect the effects of the shelterwood harvest. It was assumed that natural regeneration would occur within 10 years following the first pass removals.

Maturity Criteria

Maturity ages were the same as used in Run 2. Once a stand was deemed mature then it was available for shelterwood harvesting, followed 20 years later by the final harvest.

Treatment Costs

The same treatment costs as were used in Run 2 were used in this run.

Run 10. Shelterwood Harvest on Run 3

This run illustrates the effects of shelterwood harvest removals on the Selective Silviculture management option. The same silvicultural treatments and costs as used in Run 3 were used in this run.

Regeneration Delays

Regeneration delays were the same as was assumed in Run 9; ie., it was assumed that natural regeneration would occur within 10 years of the first pass.

Maturity Criteria

The same maturity criteria as was used in Run 3 were used in this run.

Treatment Costs

The same treatment costs as were used in Run 3 were used in this run.

Run 11. Recreation/Aesthetic Buffers, Wilderness Removal

This scenario attempts to simulate the effects of leaving natural buffer strips along the major roads, streams and lakes. The areas included within these buffer strips was removed from the active commercial timber landbase. In addition, a area of 9240 ha was removed for inclusion in a designated wilderness area.

The net remaining landbase was managed using the same silvicultural activities and assumptions as was used in Run 2, MOF Basic Silviculture. Normal clearcut harvesting practices were assumed.

Regeneration Delays

The same regeneration delays as used in Run 2 were used in this run.

Maturity Criteria

The same maturity criteria as used in Run 2 were used in this run.

Treatment Costs

The same treatment costs as used in Run 2 were used in this run.

Run 12. Winter Range Areas Removed From Run 2

This run illustrates the effect of removing winter range habitat from the operating timber landbase. In this scenario, 8620 ha were removed from timber production. The majority of this land is currently classed as good and medium site Douglas-fir. These timber types are among the most productive in the estate. As a result, the removal of winter ranges has a significant effect on the long-run sustainable harvest level.

Regeneration Delays

The same regeneration delays as assumed in Run 2 were used.

Maturity Criteria

The same maturity criteria as used in Run 2 were used.

Treatment Costs

The same treatment costs as used in Run 2 were used.

Run 13. Intensive Silviculture to Replace Effects of Run 11

This run illustrates the difficulties and scope of increased silvicultural activities necessary to makeup the reductions in fibre flows on the reduced productive landbase stemming from Run 11. In effect, it is necessary to implement a silvicultural program like that depicted in Run 4 (maximum fibre production) plus commercially thin all stands.

While this is technically feasible, historically it has not been operationally feasible to do this.

Regeneration Delays

Regeneration delays and planting activities were the same as used in Run 4.

Intensive Silviculture

All sites were promptly planted. All sites were spaced to remove excessive competition and to improve crop tree growing space and distribution. All sites were fertilized at least twice. All sites were commercially thinned.

Maturity Criteria

The same maturity criteria as were used in Run 4 were used in this run.

Treatment Costs

Treatment costs were the same as were used as in Run 4.

Run 14. Intensive Silviculture to Replace Winter Range

This scenario is an attempt to illustrate the effort required to offset the affects of removing deer (and elk) winter range from the commercial timber land base. As can be seen from the graphs presented in Appendix II, it is not possible to totally replace the lost fibre flows. Even including all of the silvicultural activities of Run 4 (maximum fibre production) and commercially thinning every stand, a shortfall of 20,000 m^3 occurs for approximately 20 years starting in 2030.

Regeneration Delays

The same regeneration delays and planting activities as used in Run 4 were used in this run.

Intensive Silviculture

All of the activities utilized in Run 4 plus commercial thinning were used in this run. All sites were promptly planted. All sites were spaced to remove competition and improve crop tree growing space and distribution. All sites were fertilized. All sites were commercially thinned.

Maturity Criteria

The same maturity criteria as used in Run 4 were used in this run.

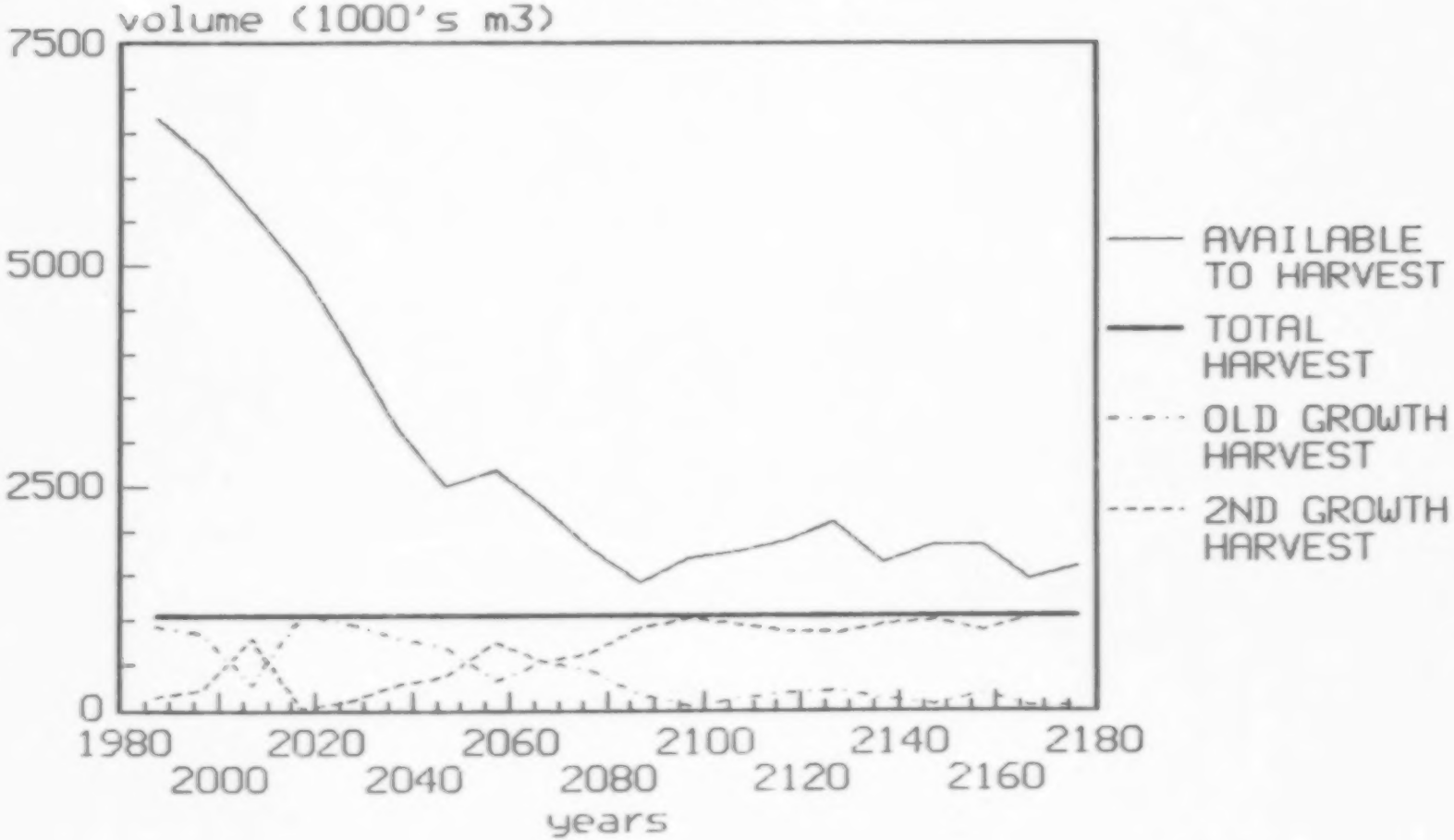
Treatment Costs

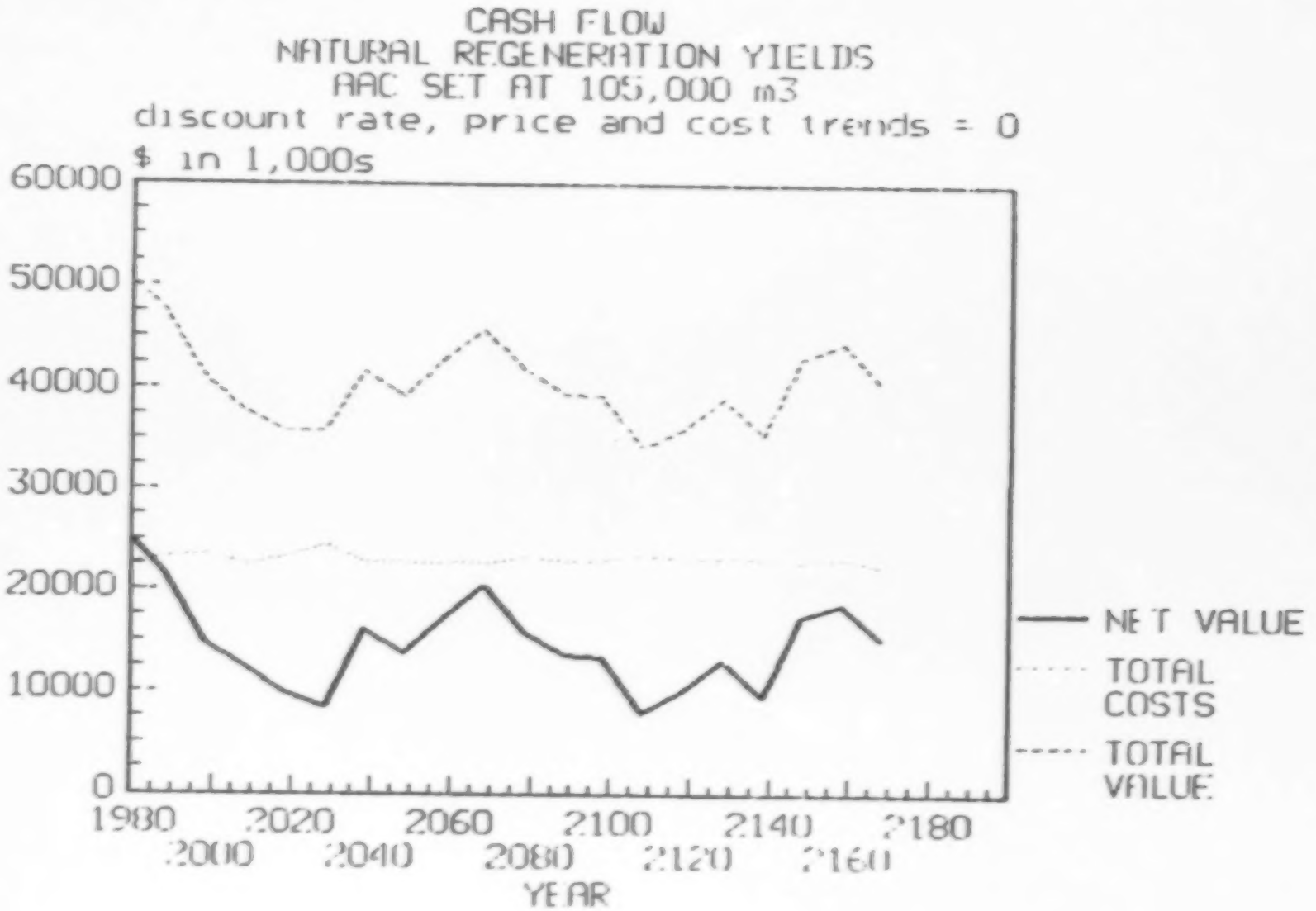
The same treatment costs and revenues as used in Run 4 were used in this run.

APPENDIX II

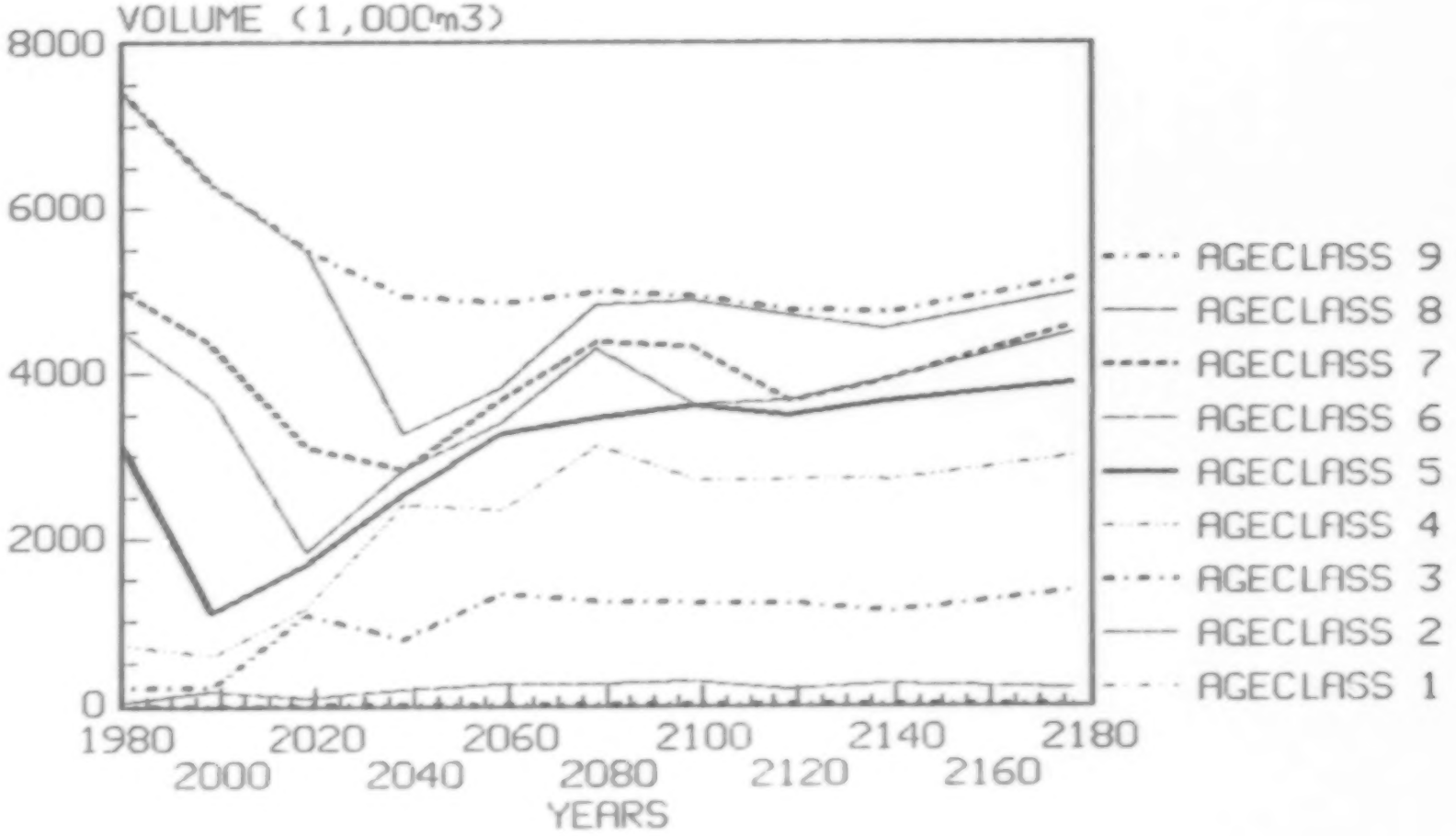
TABULAR SUMMARIES OF HARVESTS, AGE CLASS DISTRIBUTION BY AREA AND VOLUME, AND CASH FLOW, FOR 12 FOREST MANAGEMENT OPTIONS, AS DETERMINED BY FIBRPLAN-III

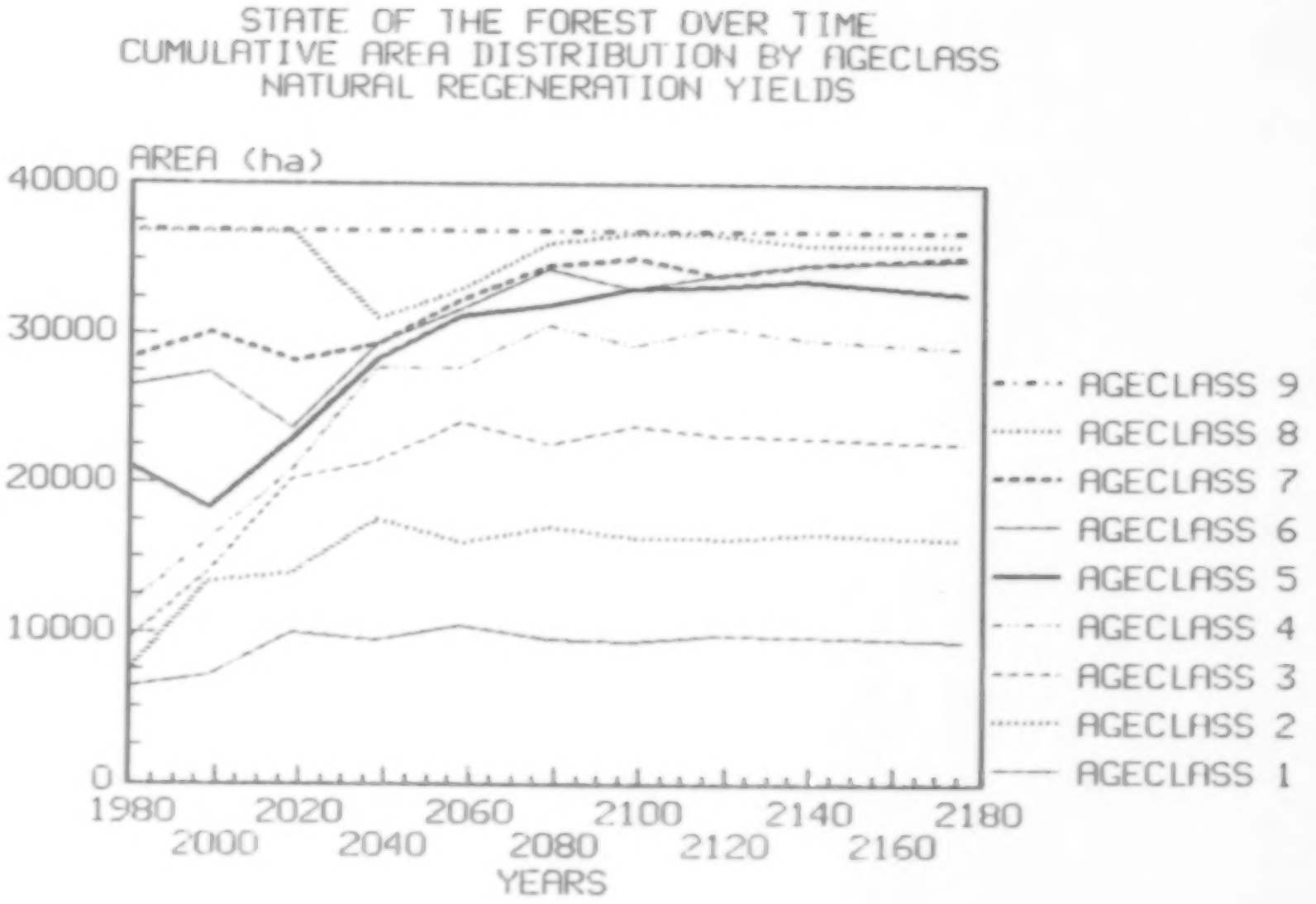
SOURCE OF HARVEST
NATURAL REGENERATION YIELDS
STANDARD UTILIZATION
AAC SET AT 105,000 m3

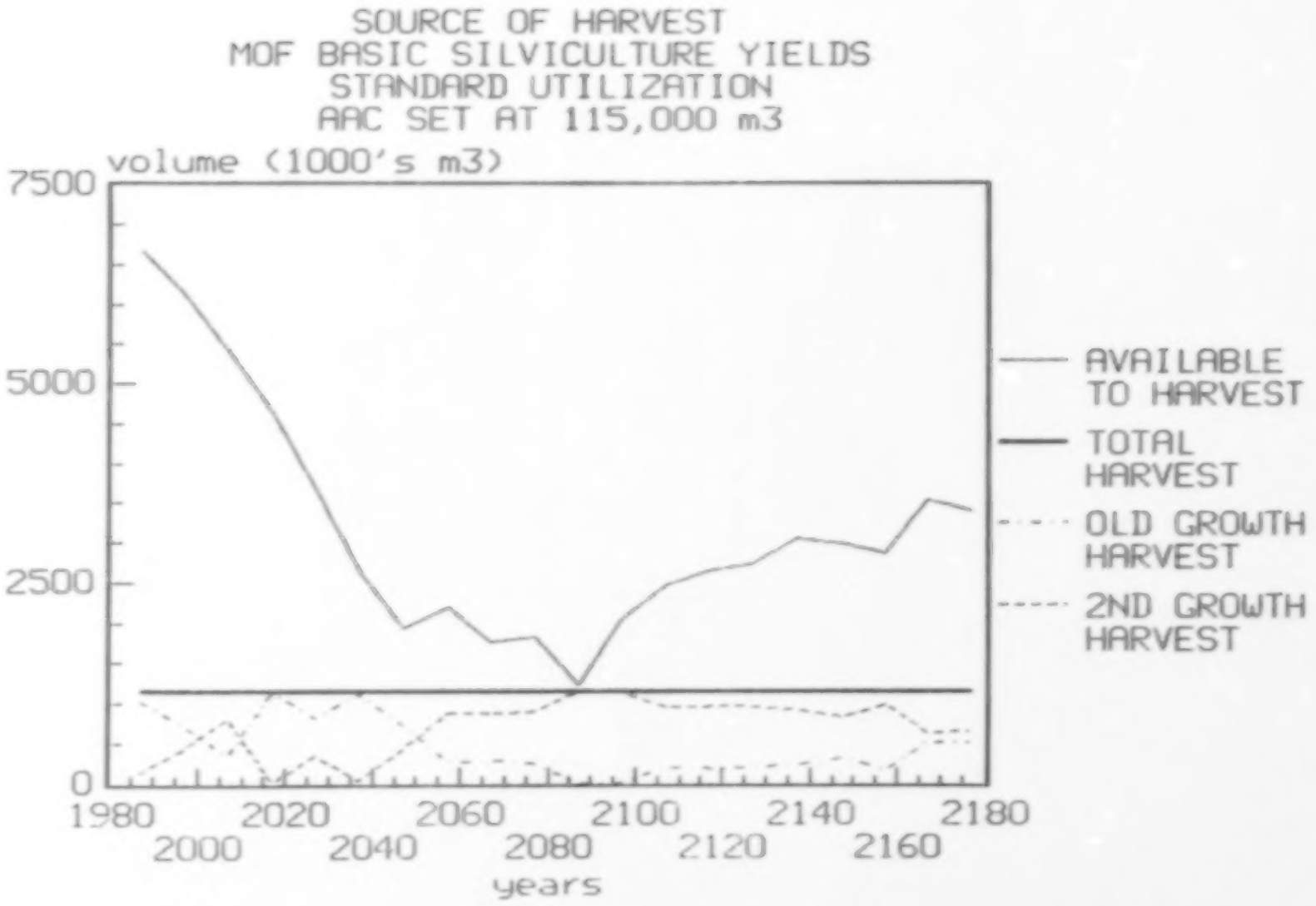


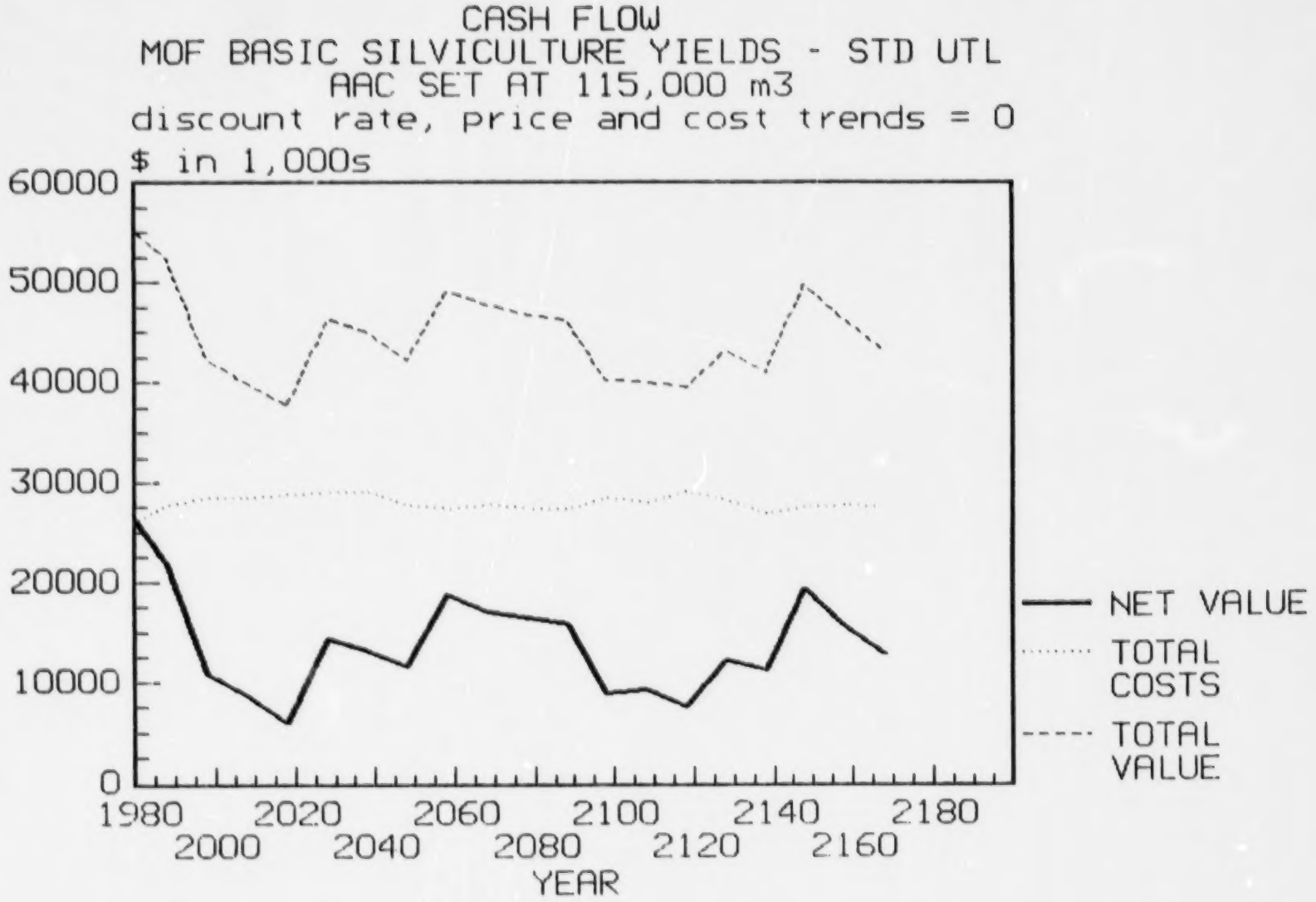

CASH FLOW
NATURAL REGENERATION YIELDS
AAC SET AT 105,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
60000
50000
40000
30000
20000
10000
0
1980
2020
2060
2100
2140
2180
2000
2040
2080
2120
2160
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
NATURAL REGENERATION YIELDS

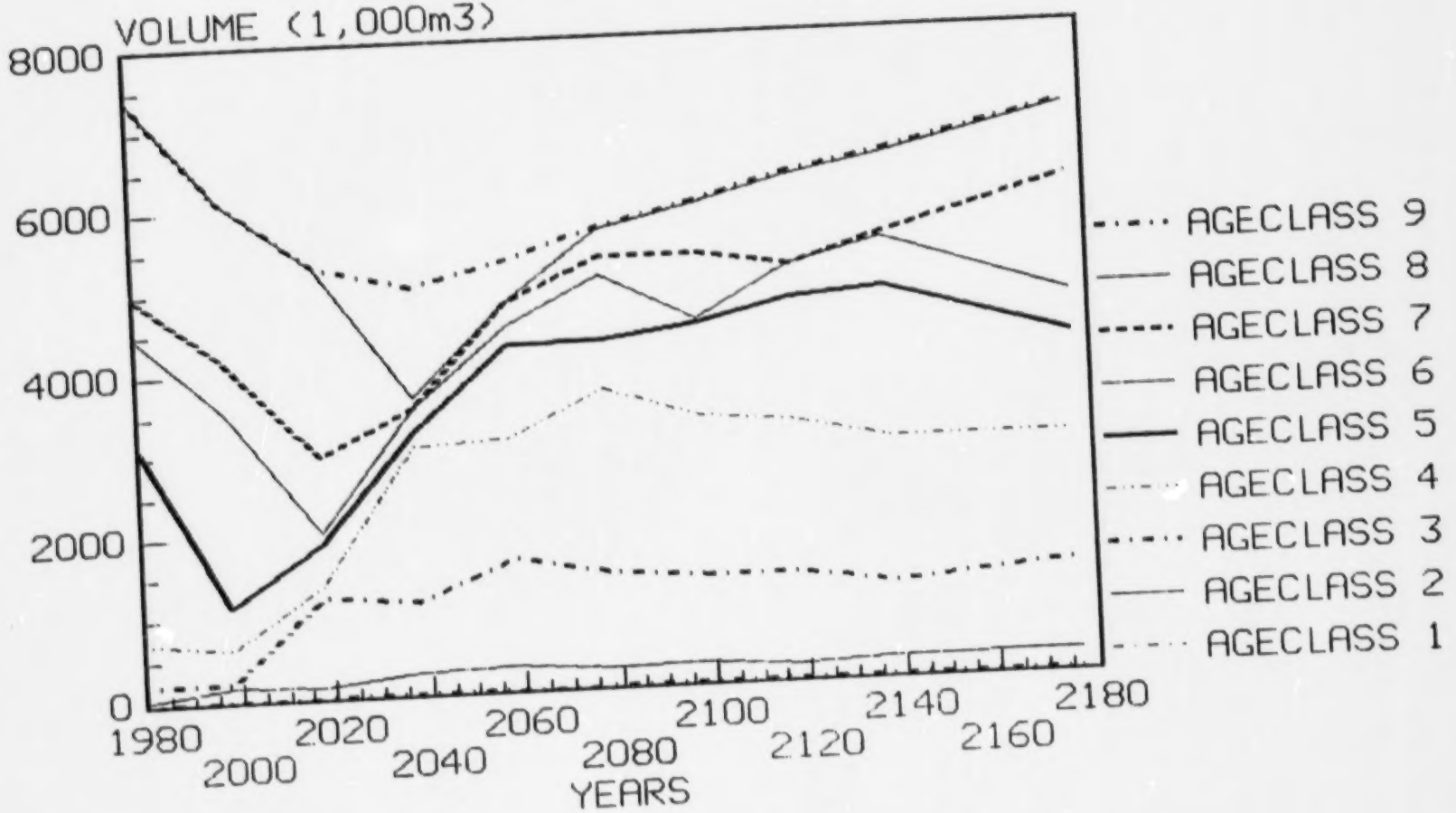


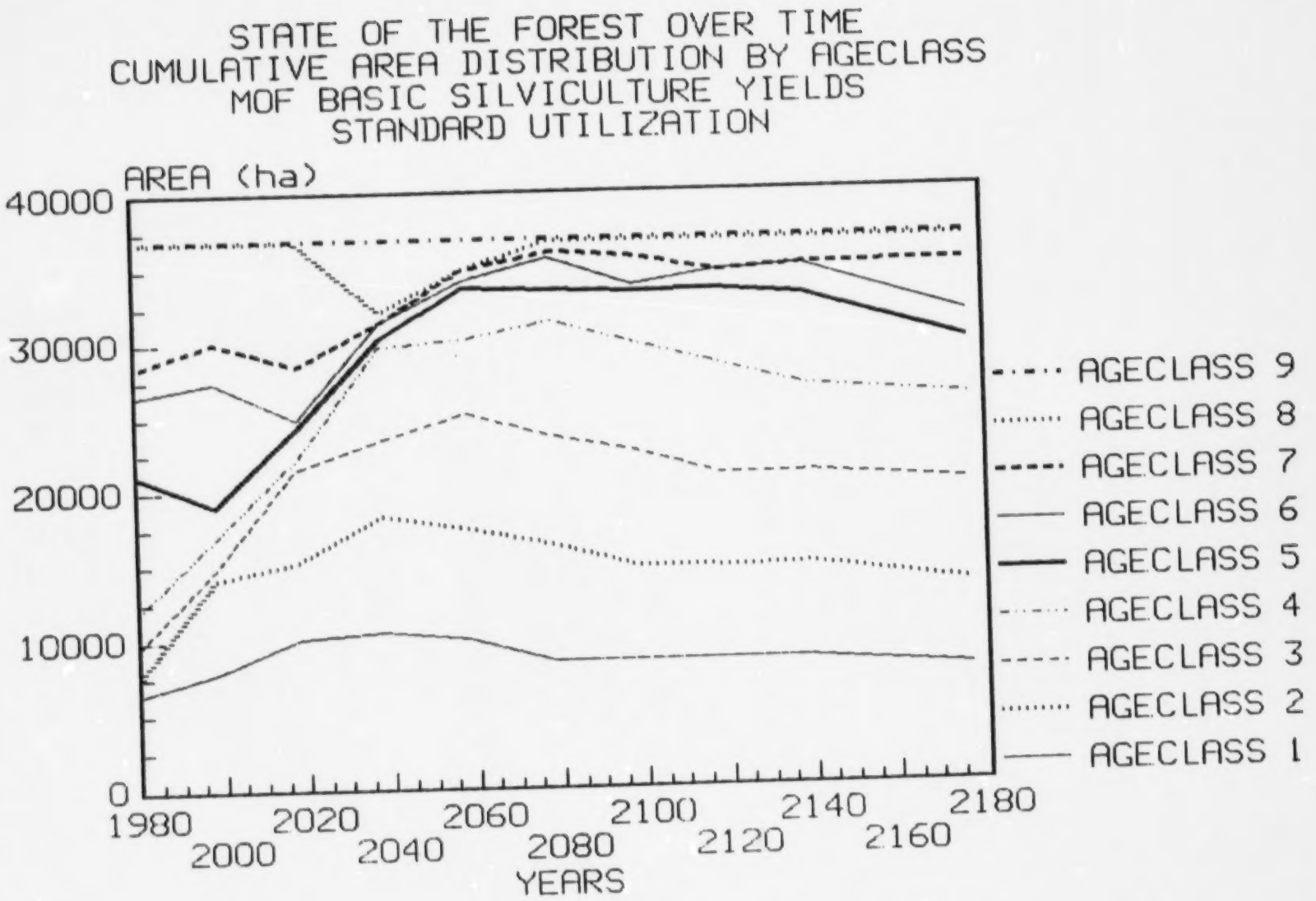

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
NATURAL REGENERATION YIELDS
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

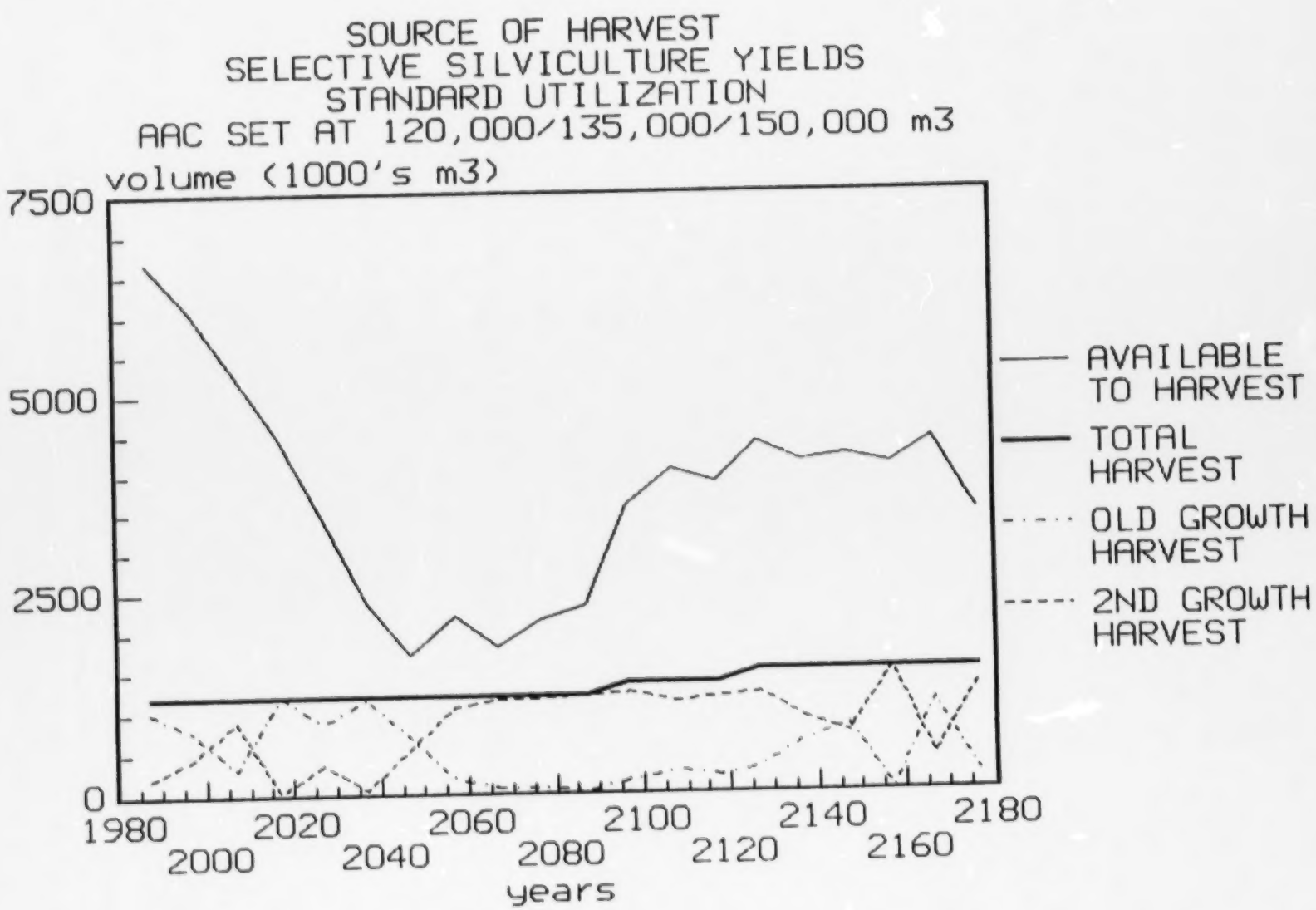

SOURCE OF HARVEST
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 115,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

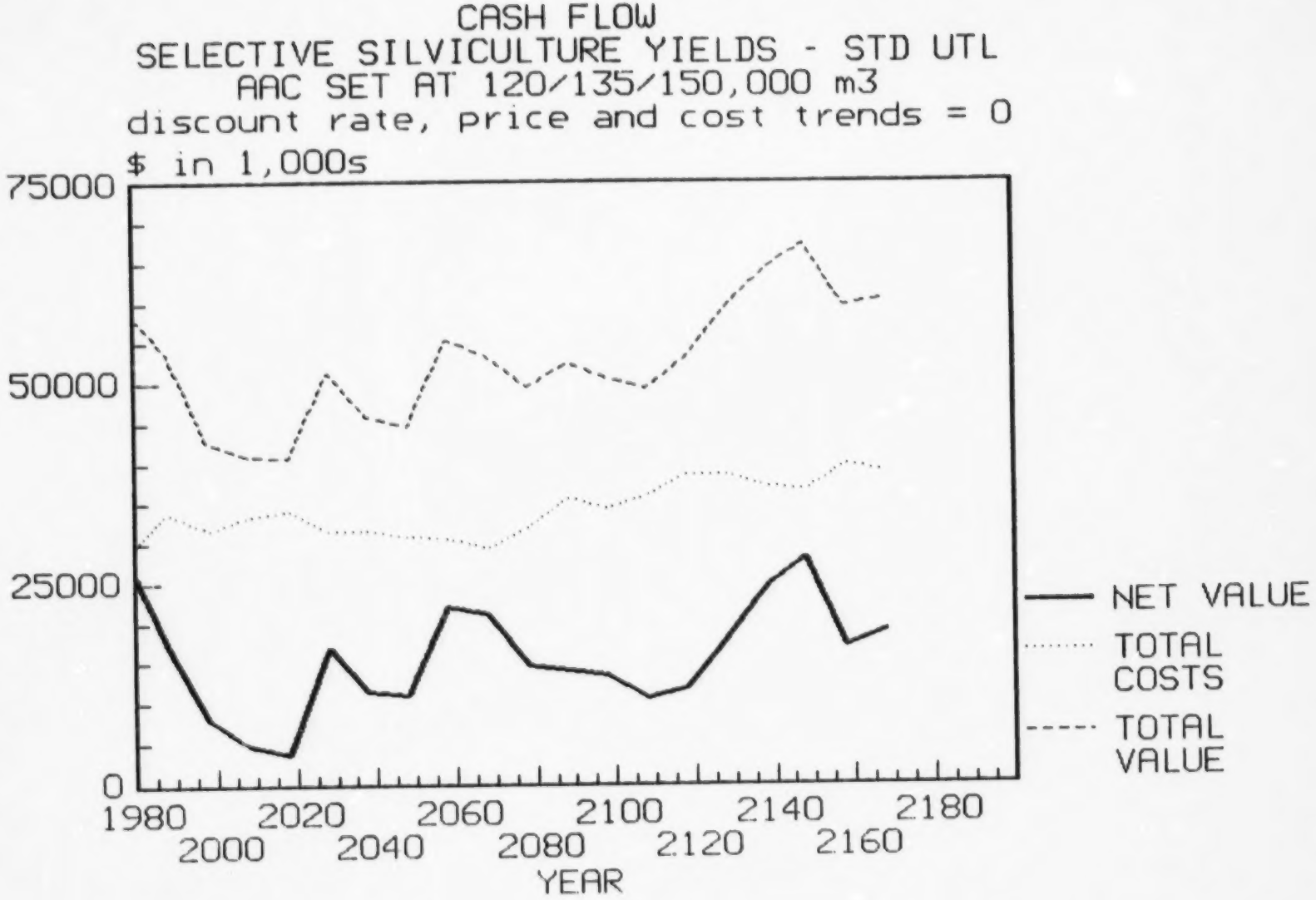

CASH FLOW
MOF BASIC SILVICULTURE YIELDS - STD UTL
AAC SET AT 115,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
60000
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

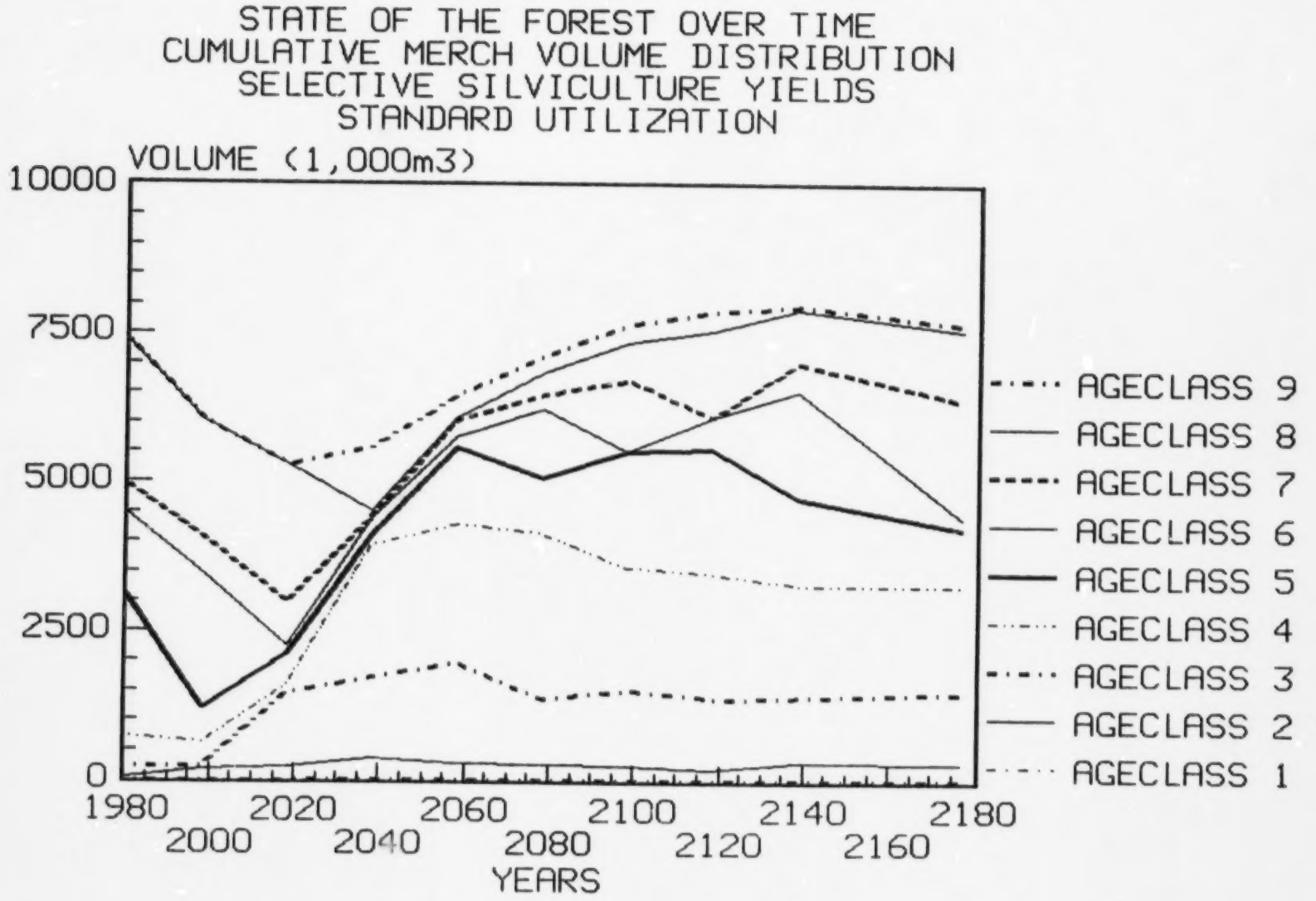
STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION

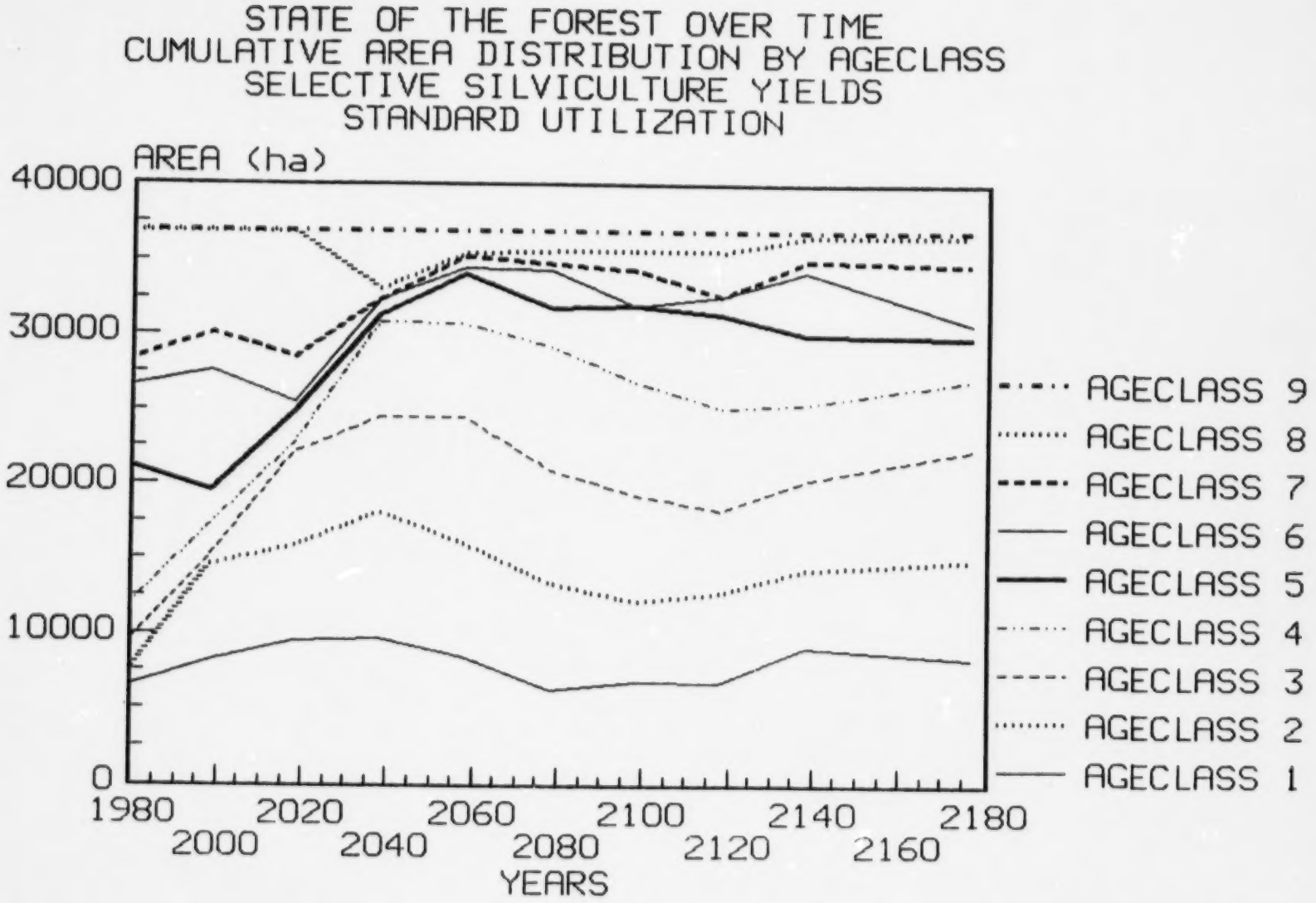



STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE YIELDS
STANDARD UTILIZATION
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

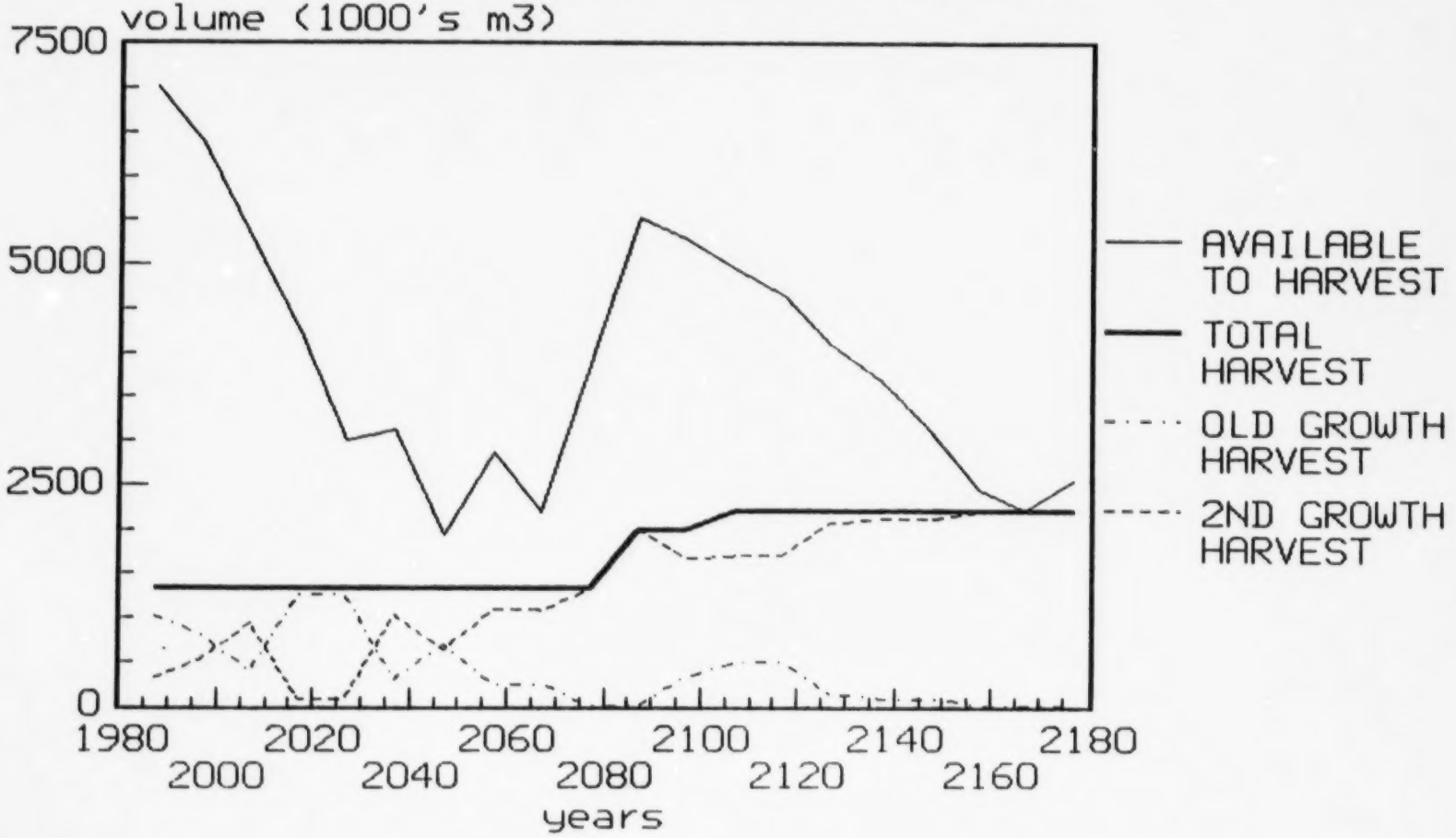

SOURCE OF HARVEST
SELECTIVE SILVICULTURE YIELDS
STANDARD UTILIZATION
AAC SET AT 120,000/135,000/150,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

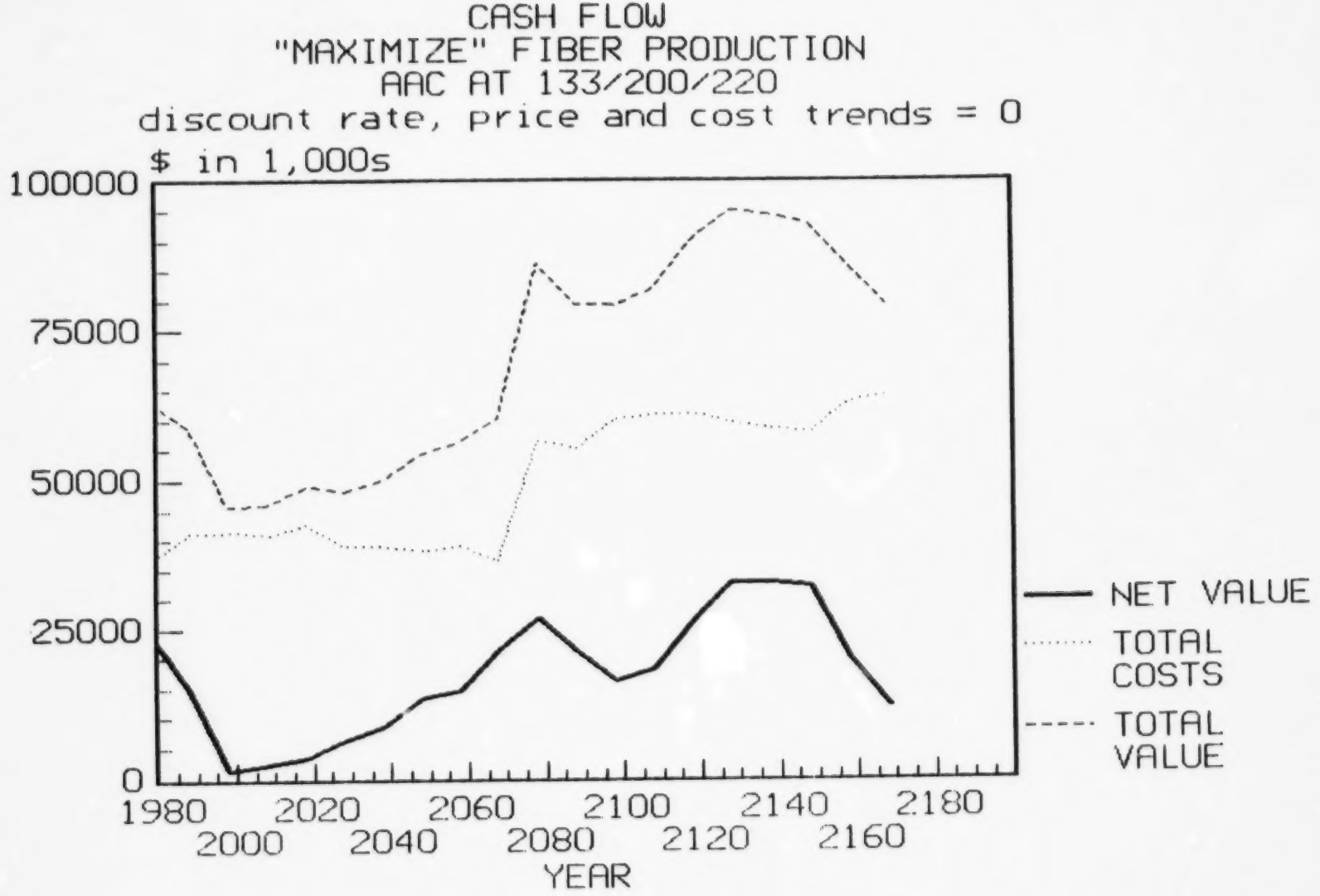

CASH FLOW
SELECTIVE SILVICULTURE YIELDS - STD UTL
AAC SET AT 120/135/150,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
75000
50000
25000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE


STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
SELECTIVE SILVICULTURE YIELDS
STANDARD UTILIZATION
VOLUME (1,000m3)
10000
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

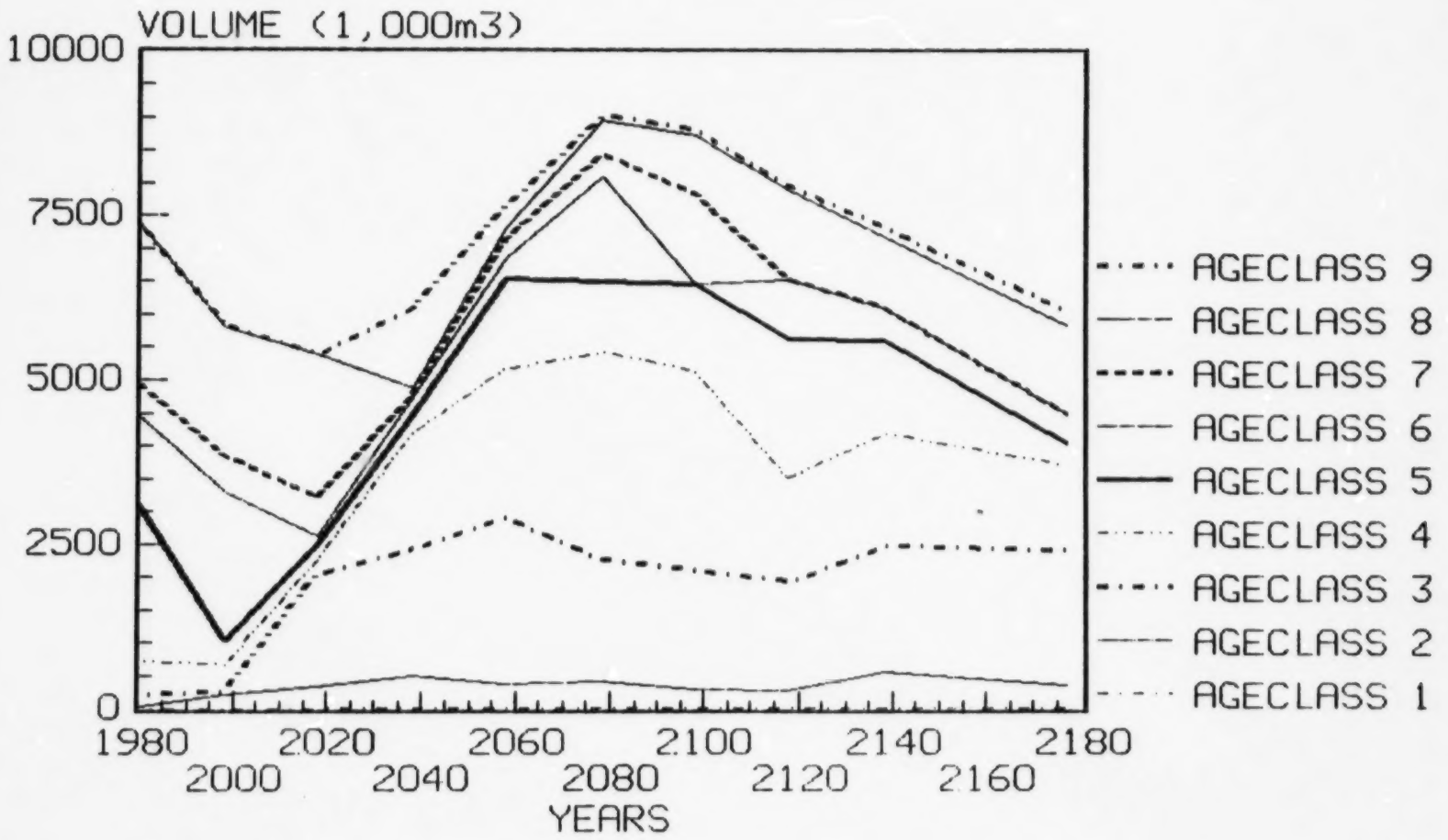

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
SELECTIVE SILVICULTURE YIELDS
STANDARD UTILIZATION
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

SOURCE OF HARVEST
"MAXIMIZE" FIBRE PRODUCTION
STANDARD UTILIZATION
AAC SET AT 133,000/200,000/220,000 m3

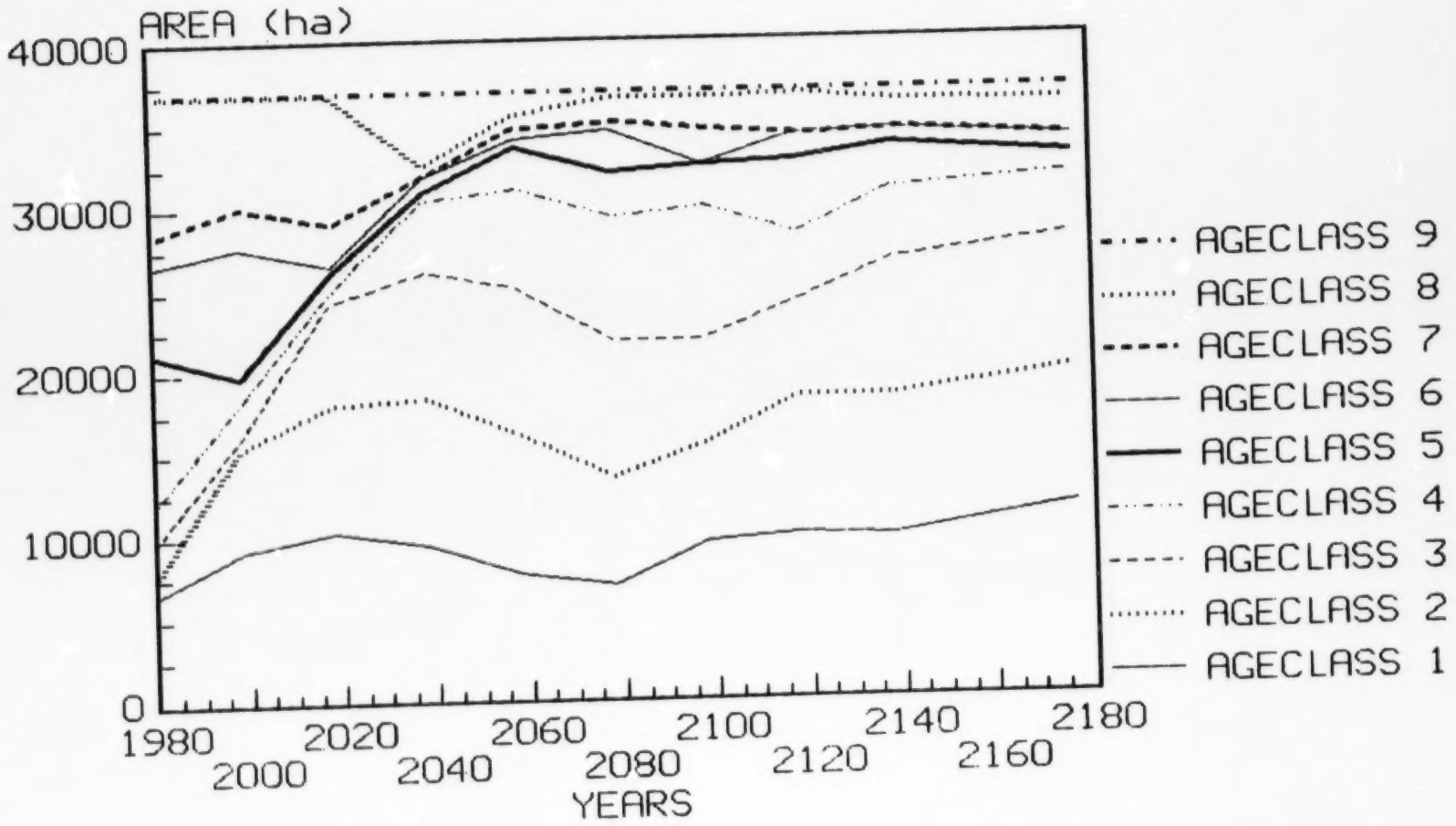


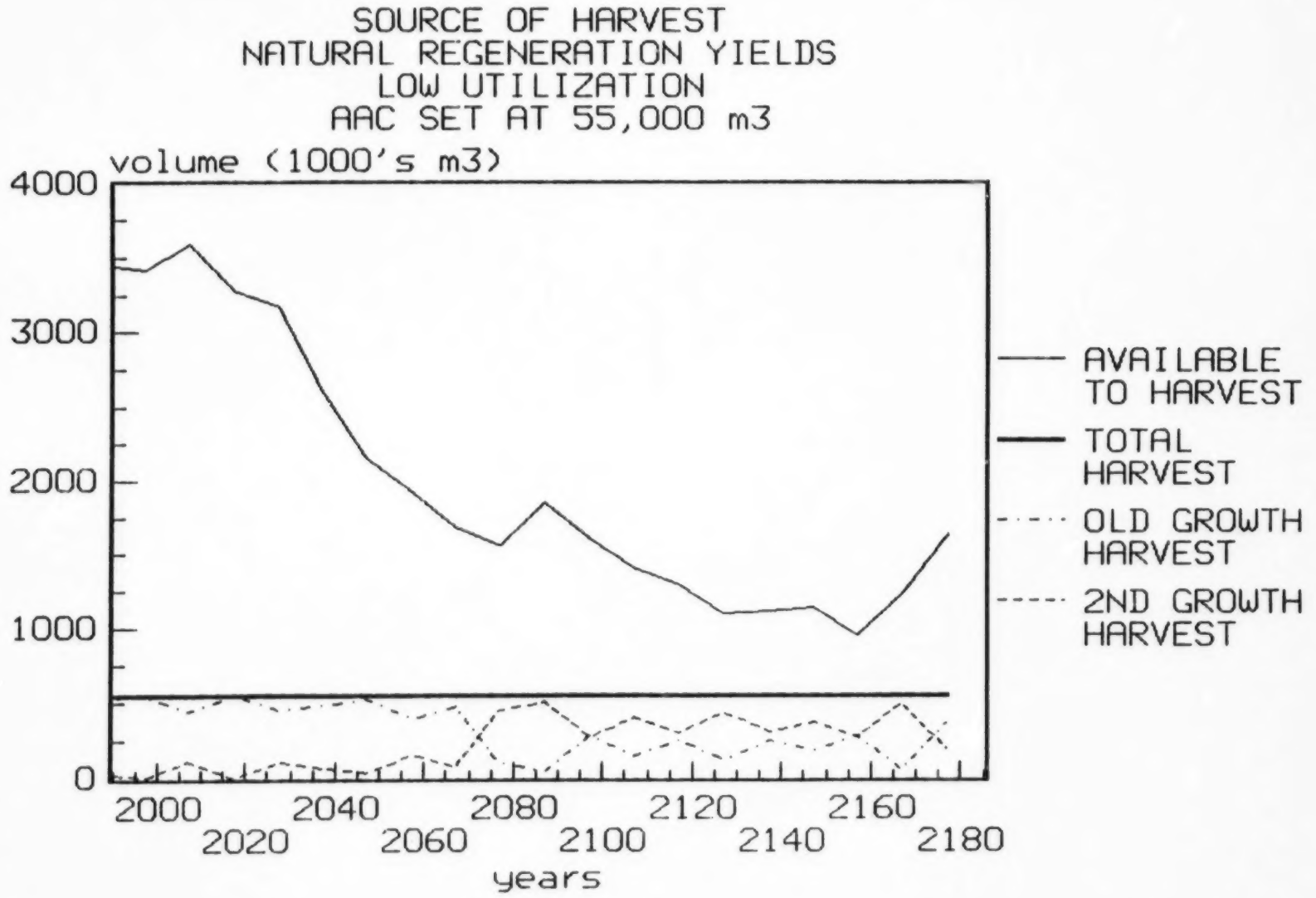

CASH FLOW
"MAXIMIZE" FIBER PRODUCTION
AAC AT 133/200/220
discount rate, price and cost trends = 0
$ in 1,000s
100000
75000
50000
25000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

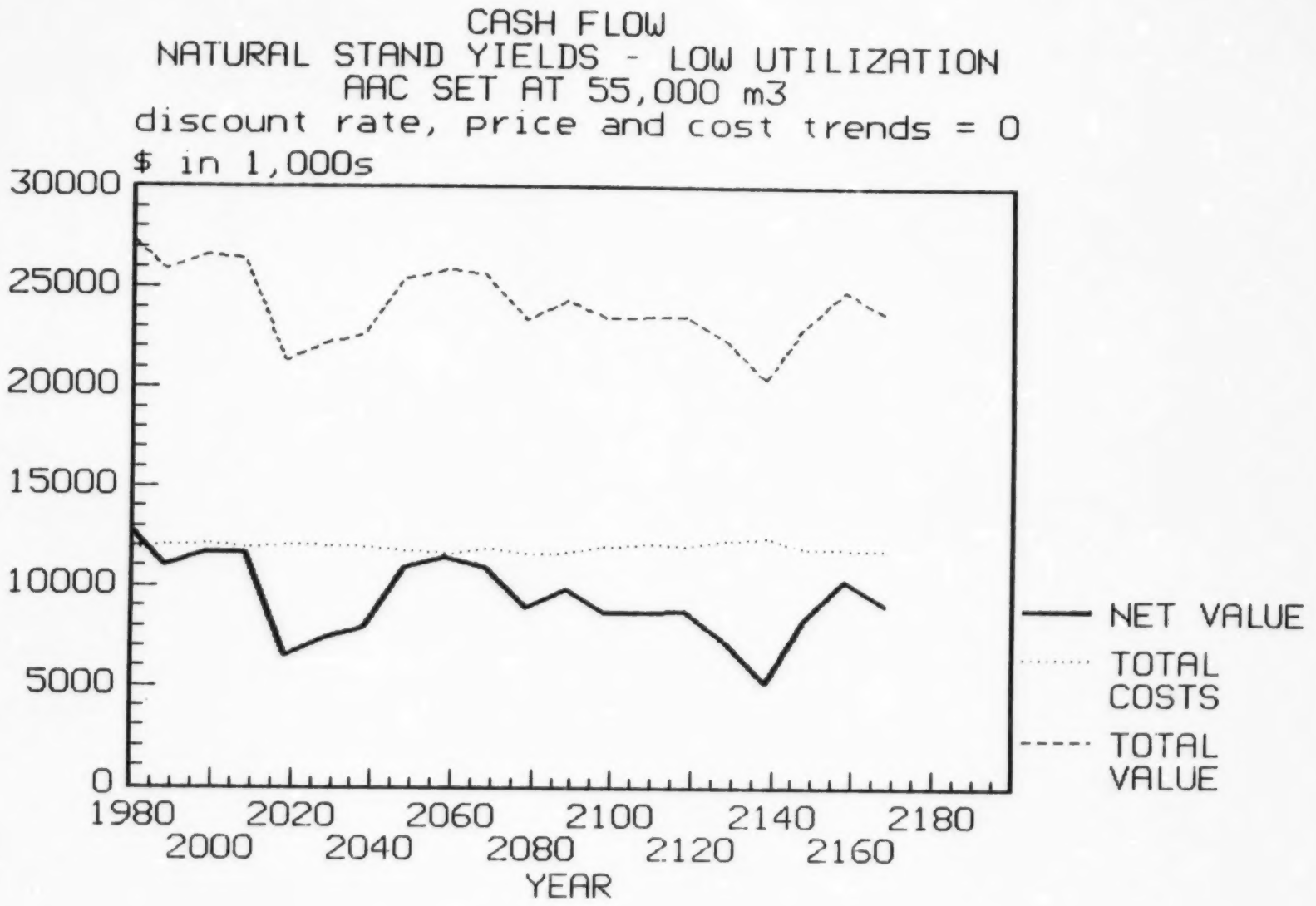
STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MAXIMIZE FIBER PRODUCTION

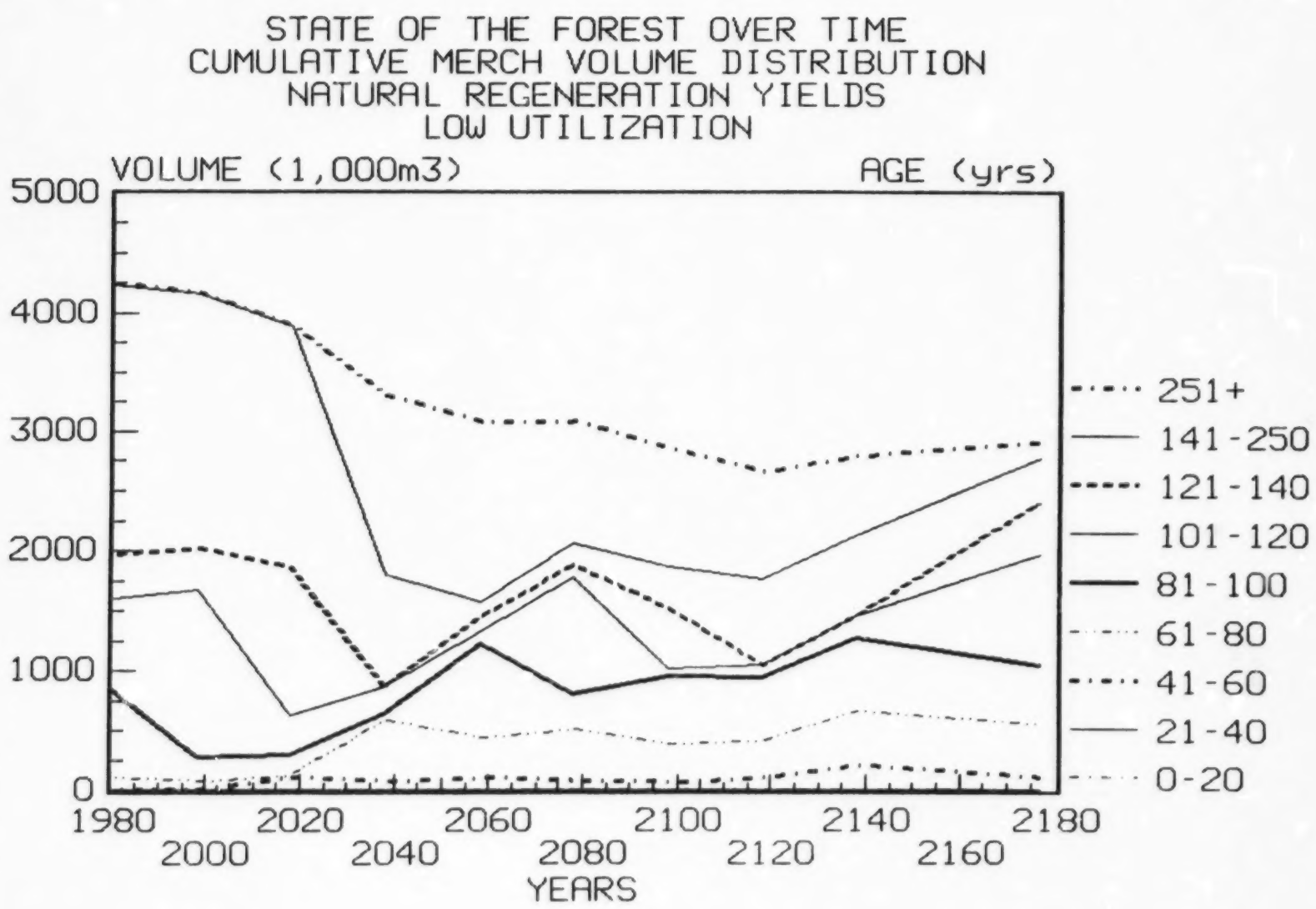


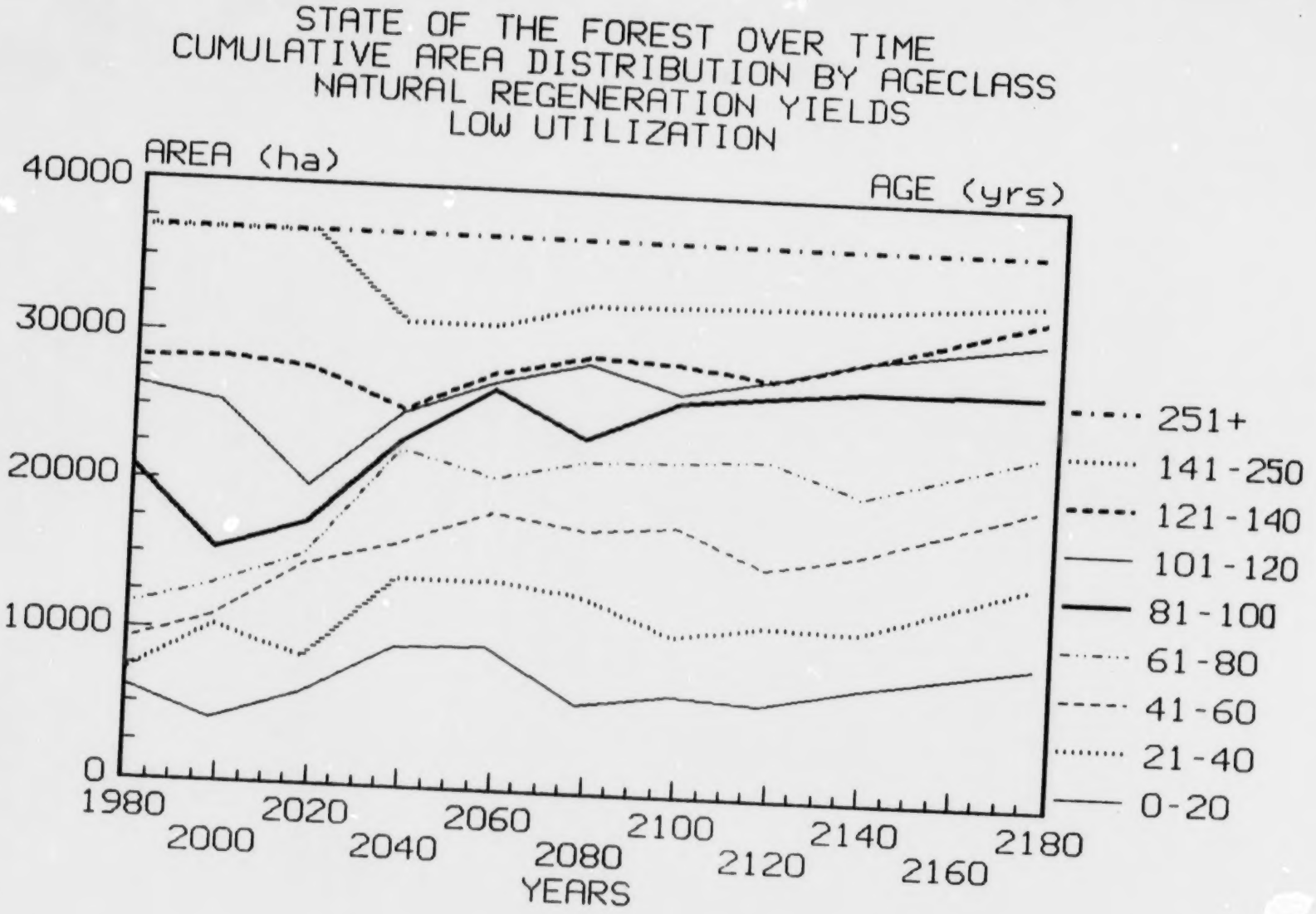
STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MAXIMIZE FIBER PRODUCTION

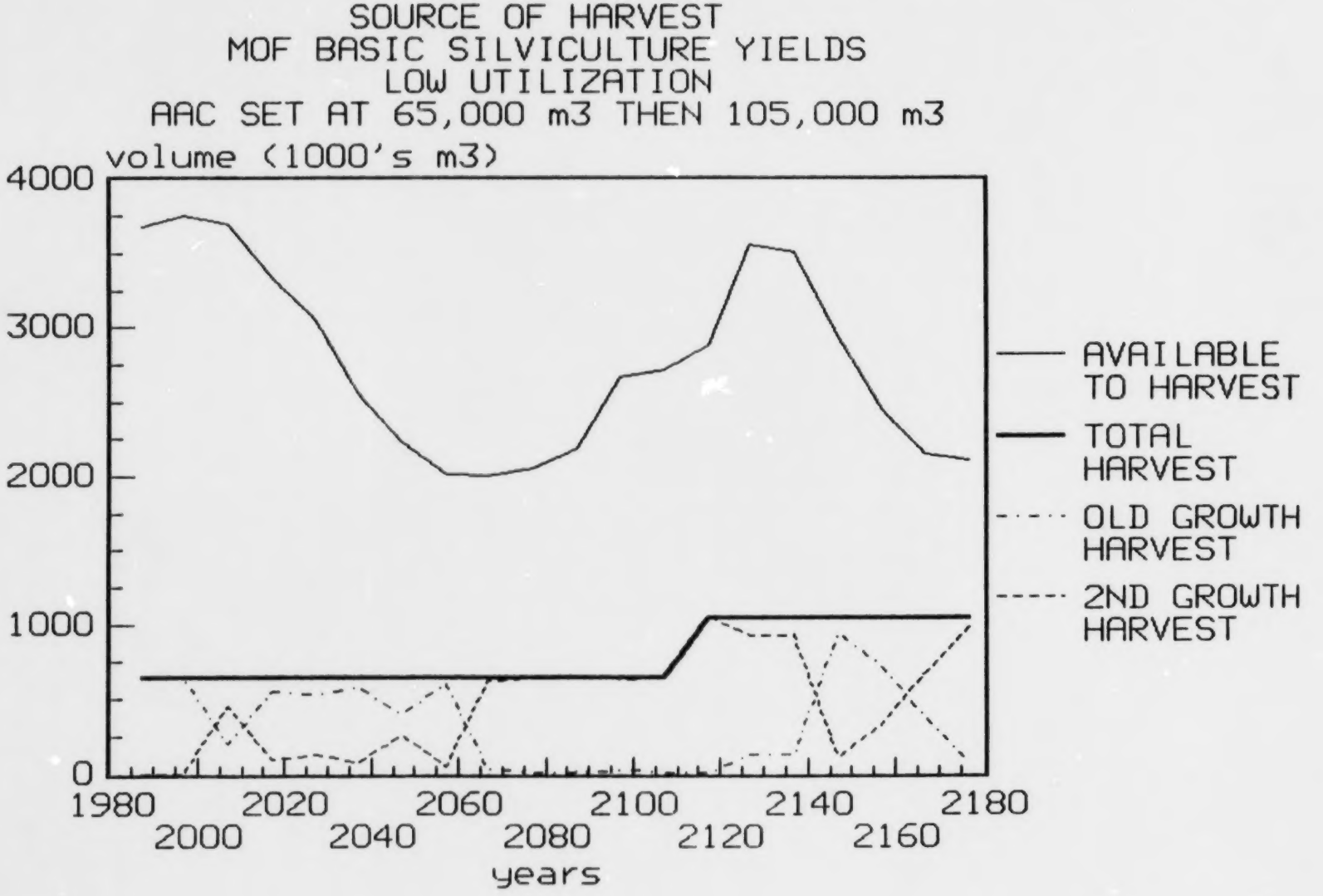


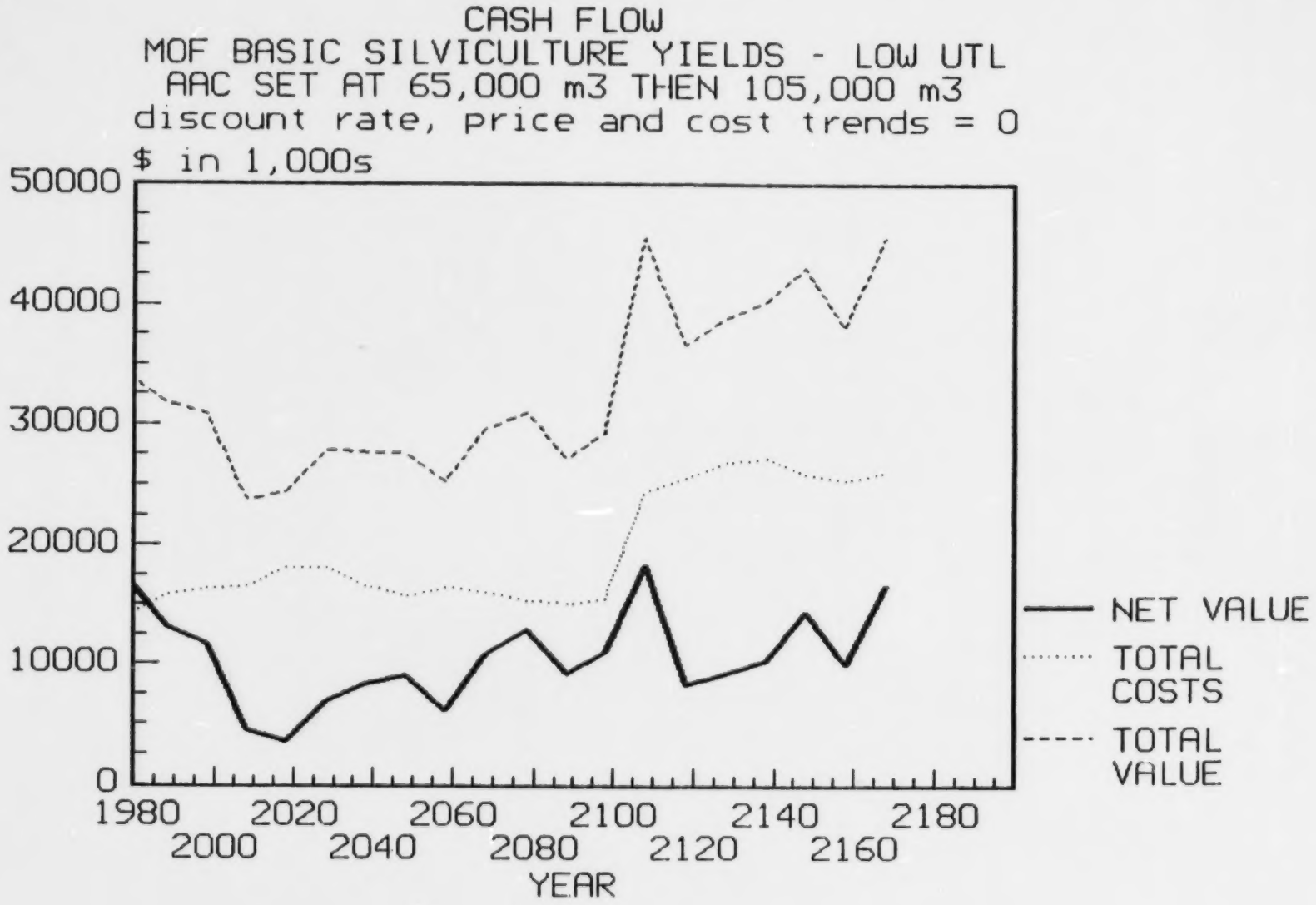

SOURCE OF HARVEST
NATURAL REGENERATION YIELDS
LOW UTILIZATION
AAC SET AT 55,000 m3
volume (1000's m3)
4000
3000
2000
1000
0
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

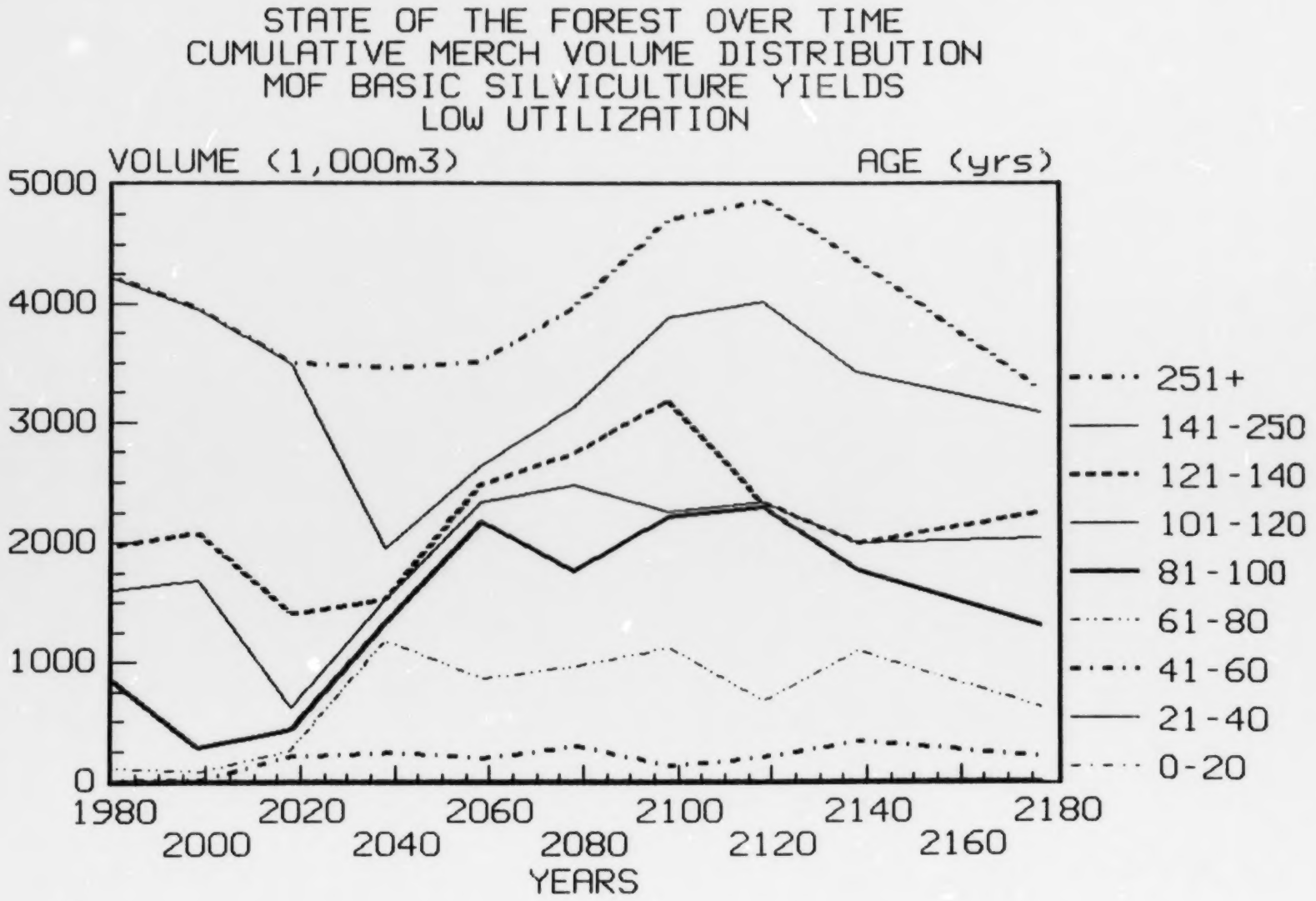

CASH FLOW
NATURAL STAND YIELDS - LOW UTILIZATION
AAC SET AT 55,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
30000
25000
20000
15000
10000
5000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

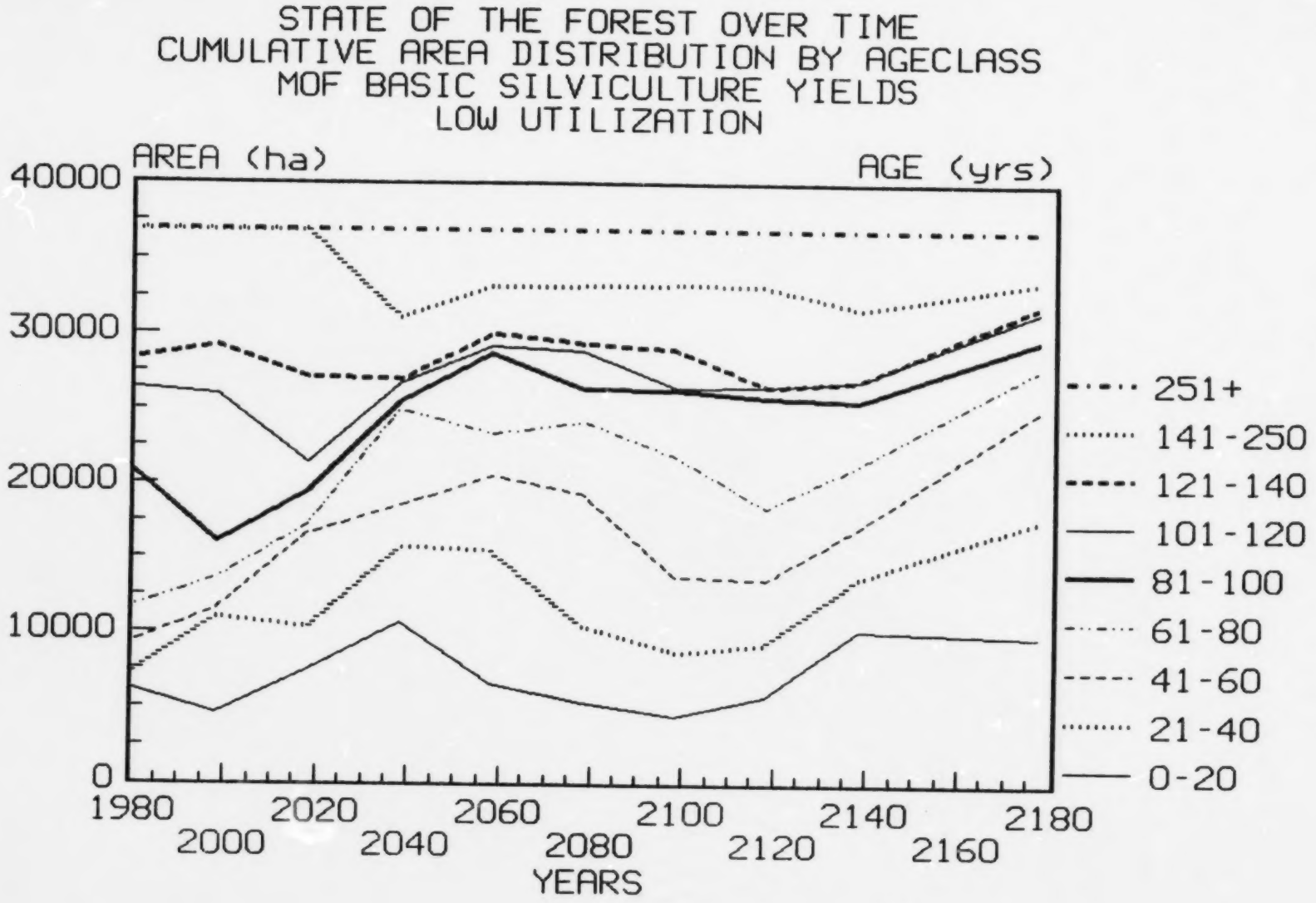

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
NATURAL REGENERATION YIELDS
LOW UTILIZATION
VOLUME (1,000m3)
AGE (yrs)
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20

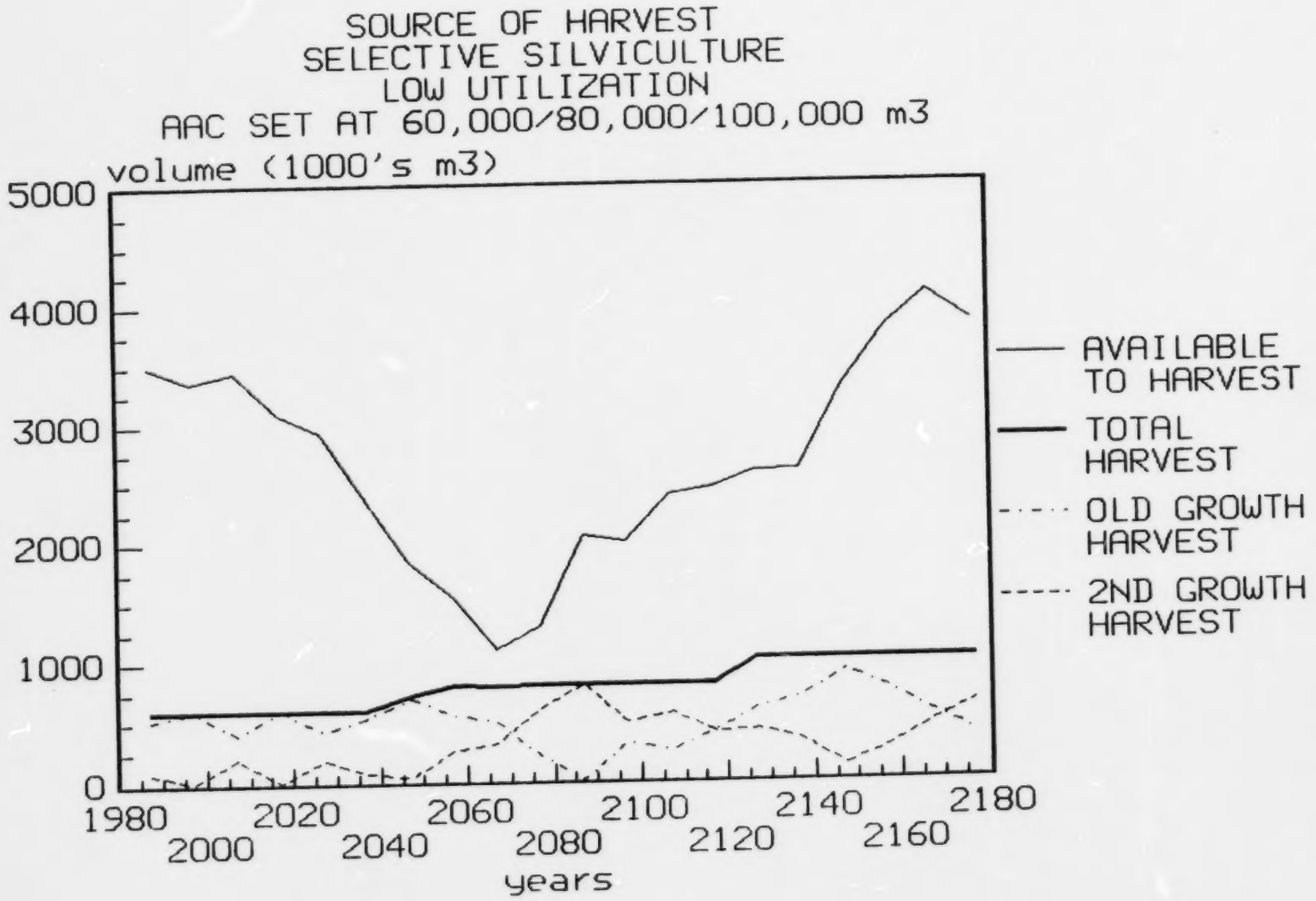

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
NATURAL REGENERATION YIELDS
LOW UTILIZATION
AREA (ha)
AGE (yrs)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20

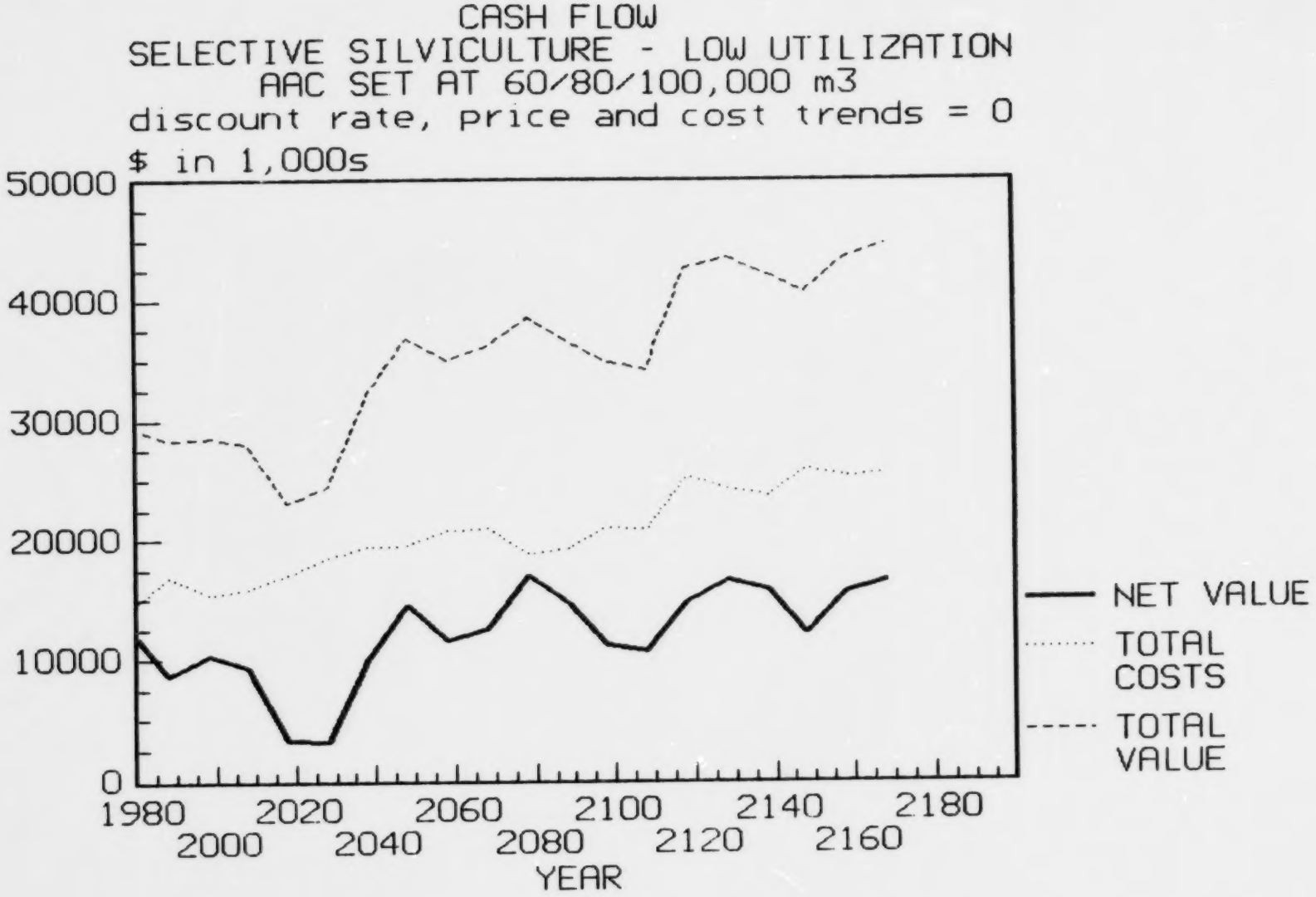

SOURCE OF HARVEST
MOF BASIC SILVICULTURE YIELDS
LOW UTILIZATION
AAC SET AT 65,000 m3 THEN 105,000 m3
volume (1000's m3)
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST


CASH FLOW
MOF BASIC SILVICULTURE YIELDS - LOW UTL
AAC SET AT 65,000 m3 THEN 105,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

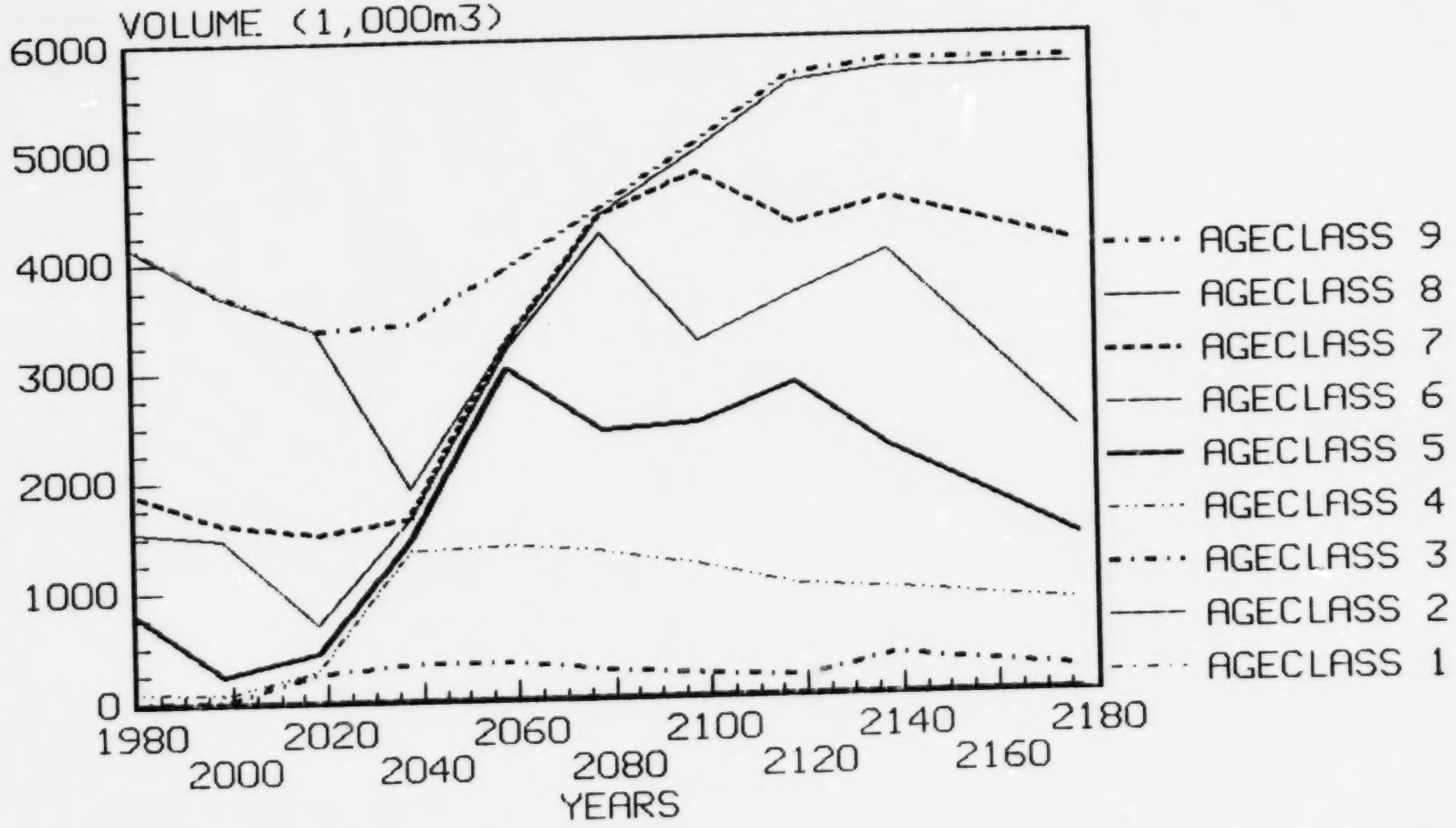

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE YIELDS
LOW UTILIZATION
VOLUME (1,000m3)
AGE (yrs)
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20

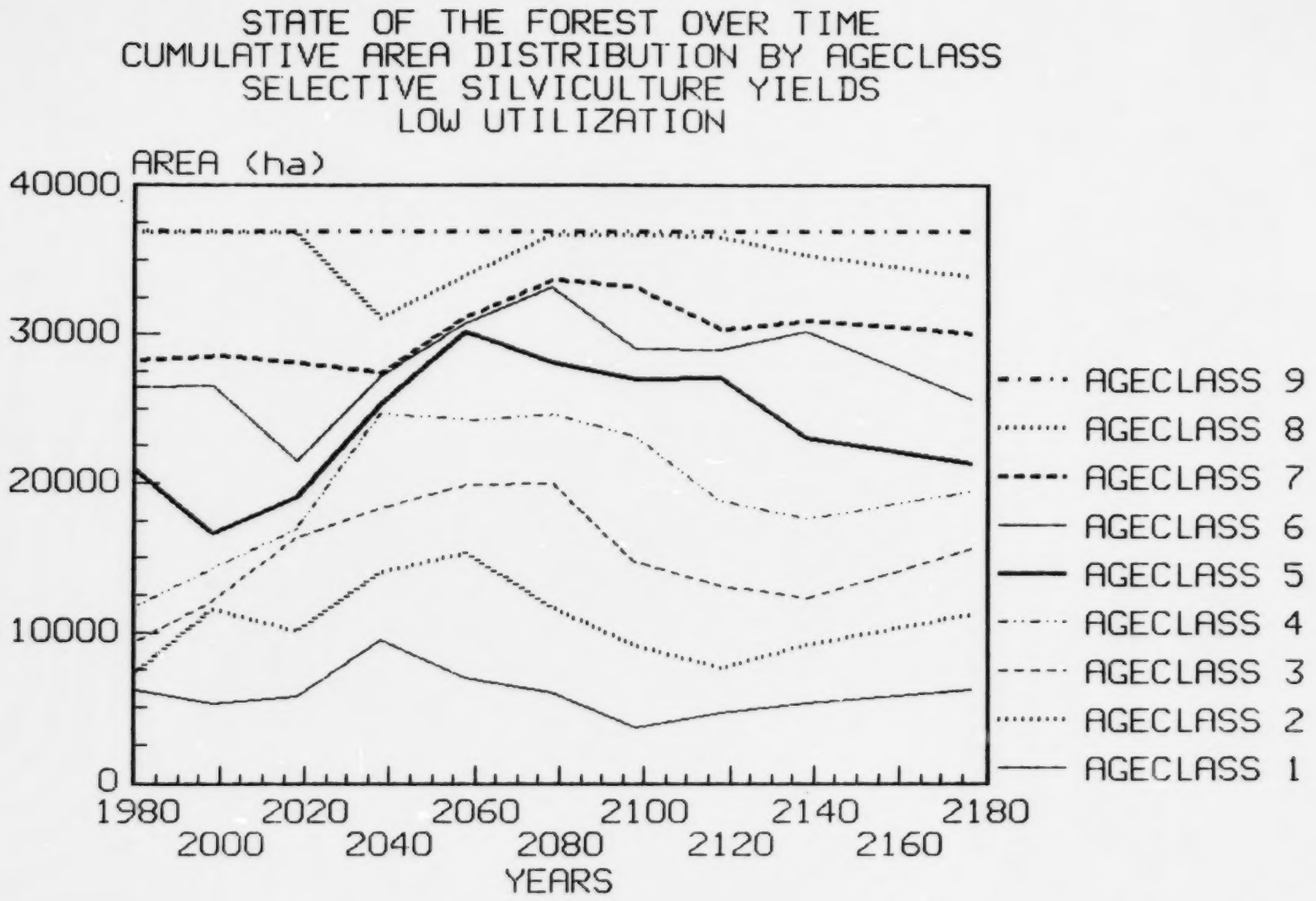

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE YIELDS
LOW UTILIZATION
AREA (ha)
AGE (yrs)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20

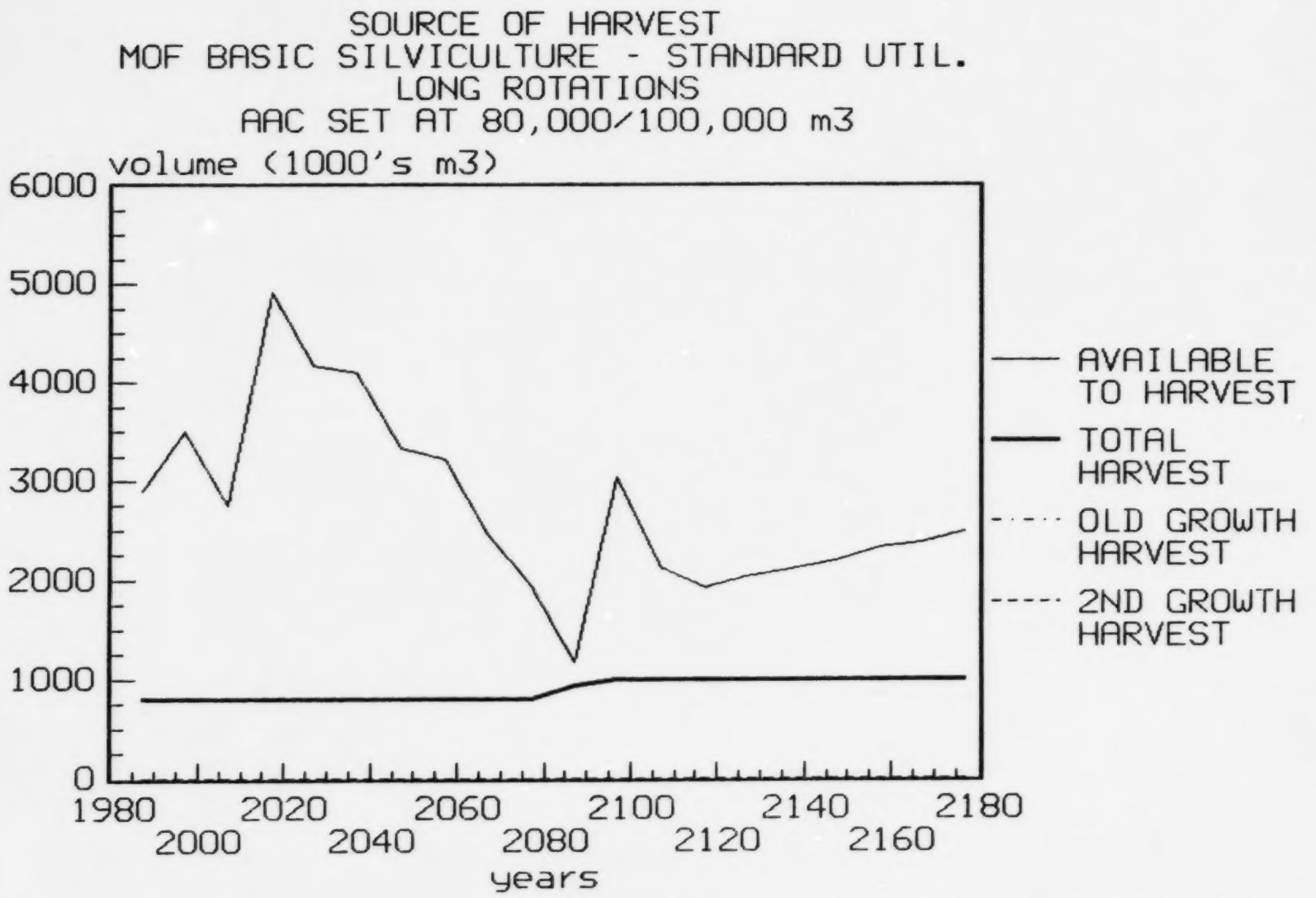

SOURCE OF HARVEST
SELECTIVE SILVICULTURE
LOW UTILIZATION
AAC SET AT 60,000/80,000/100,000 m3
volume (1000's m3)
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

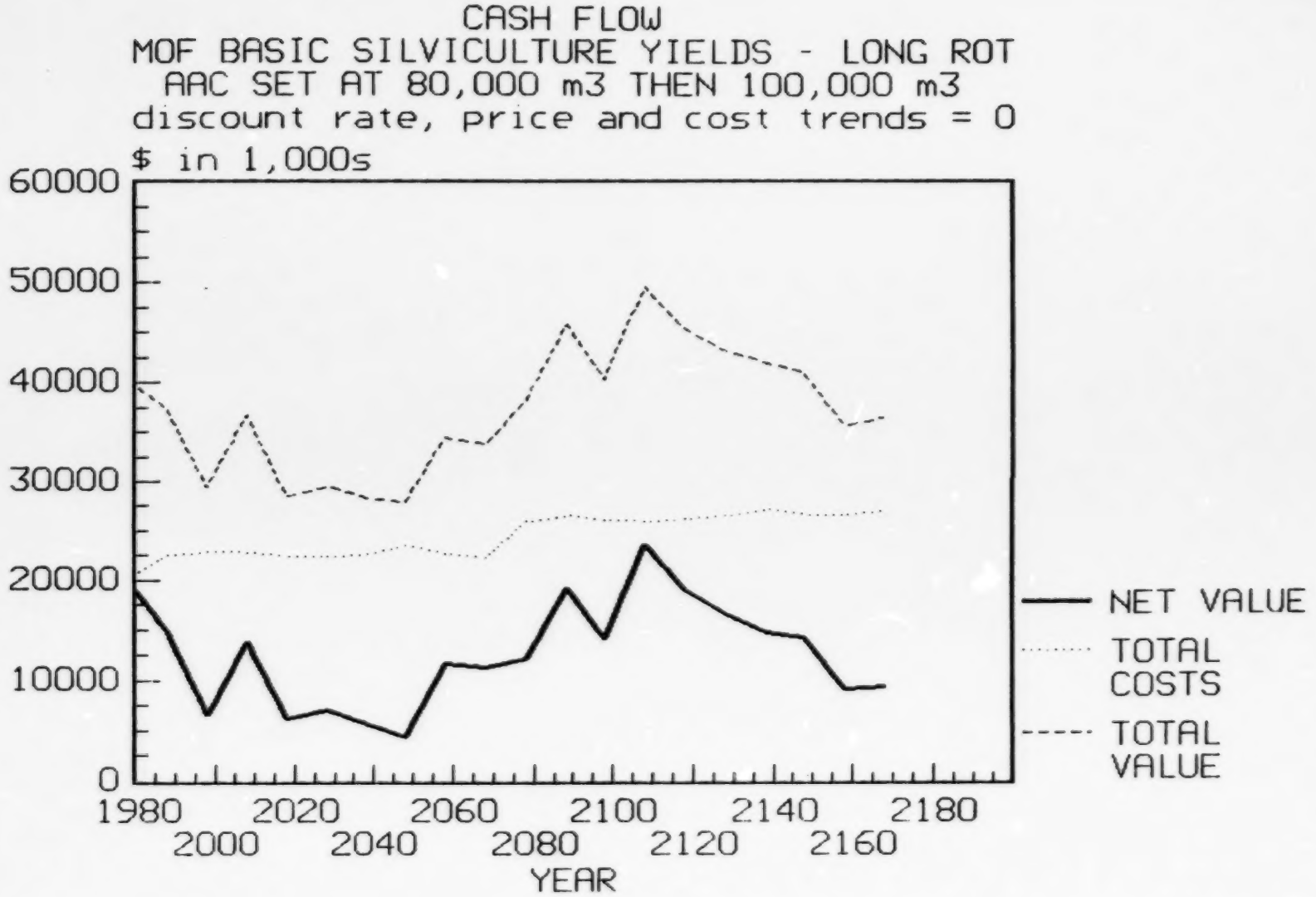

CASH FLOW
SELECTIVE SILVICULTURE - LOW UTILIZATION
AAC SET AT 60/80/100,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

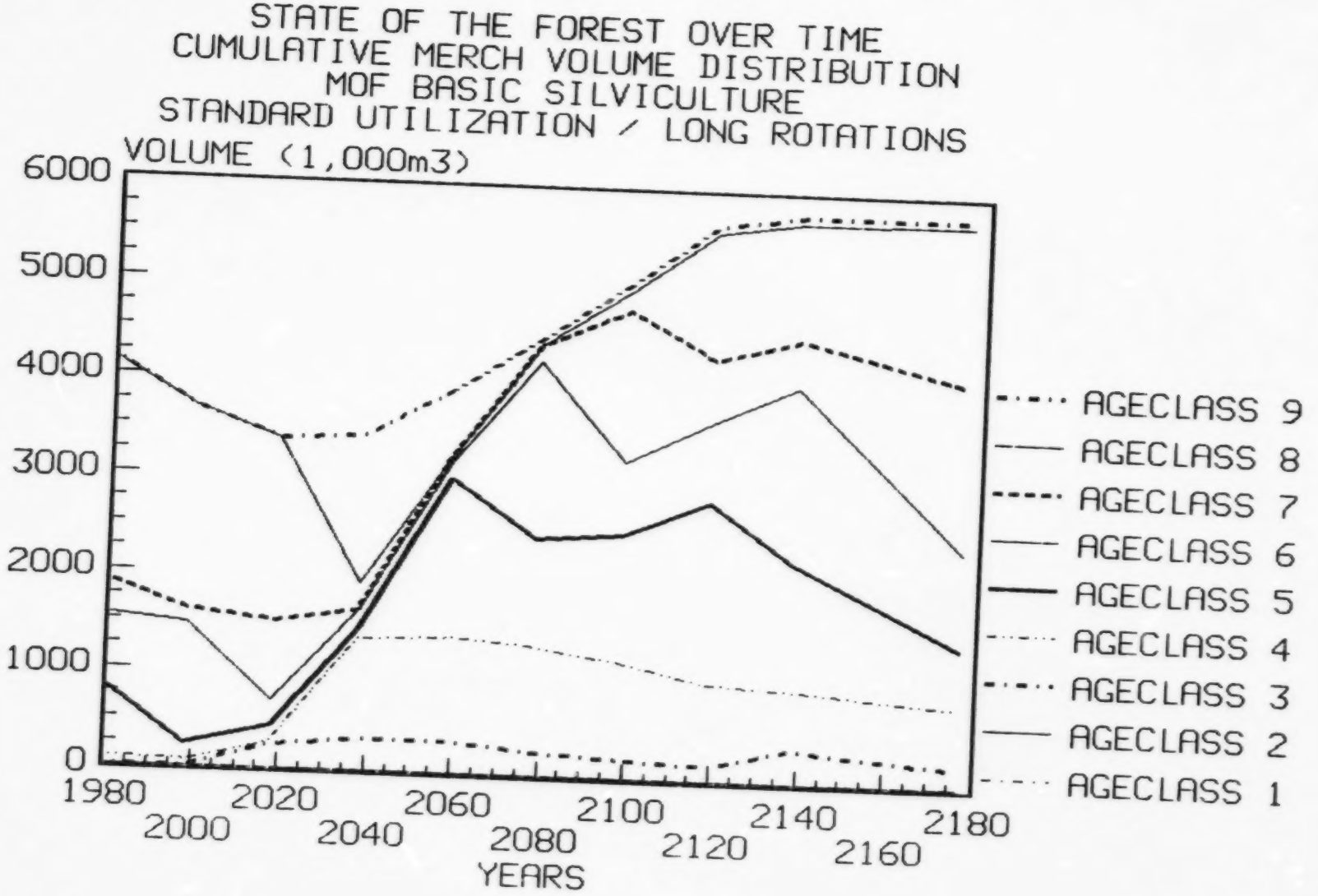
STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
SELECTIVE SIVICULTURE YIELDS
LOW UTILIZATION

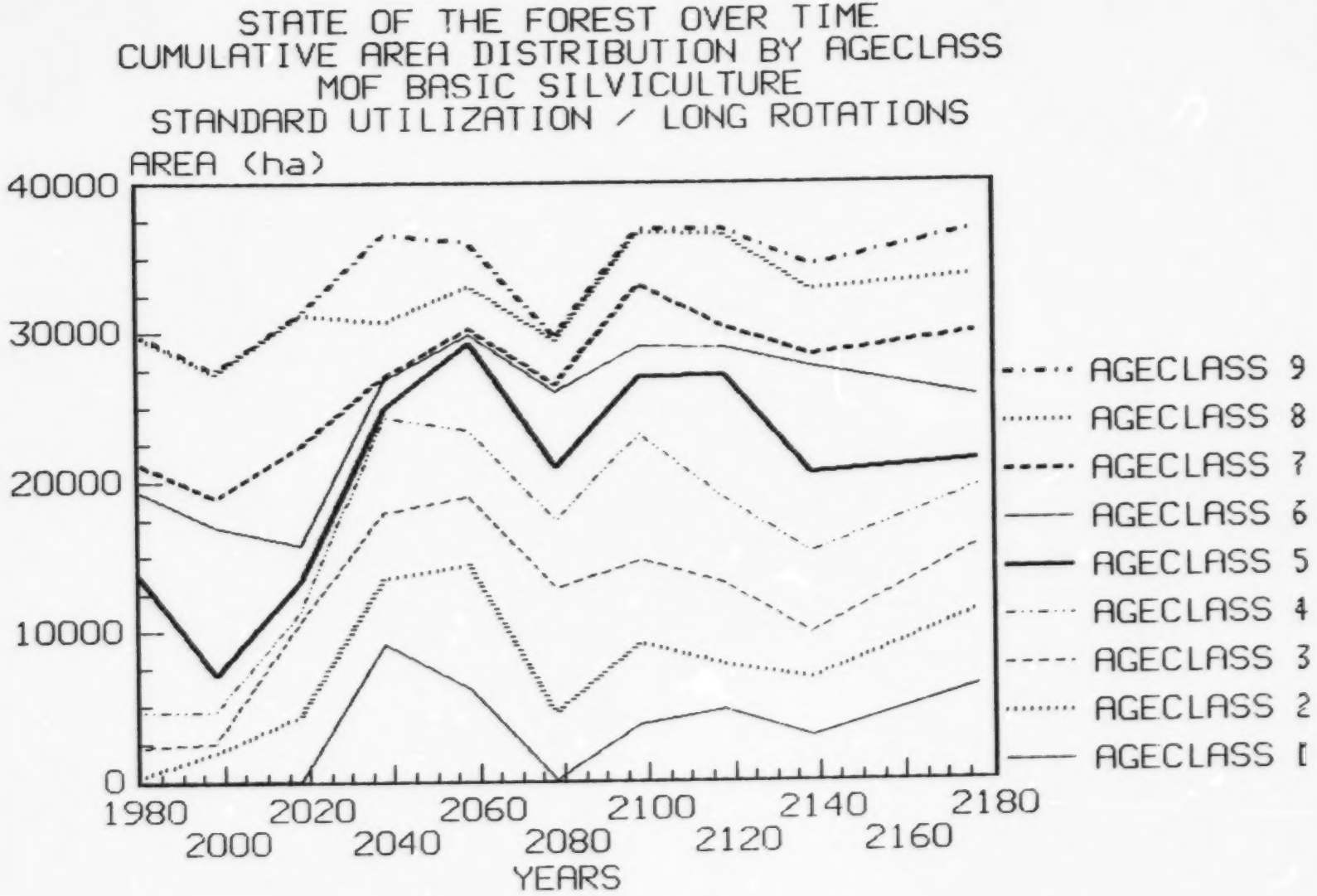


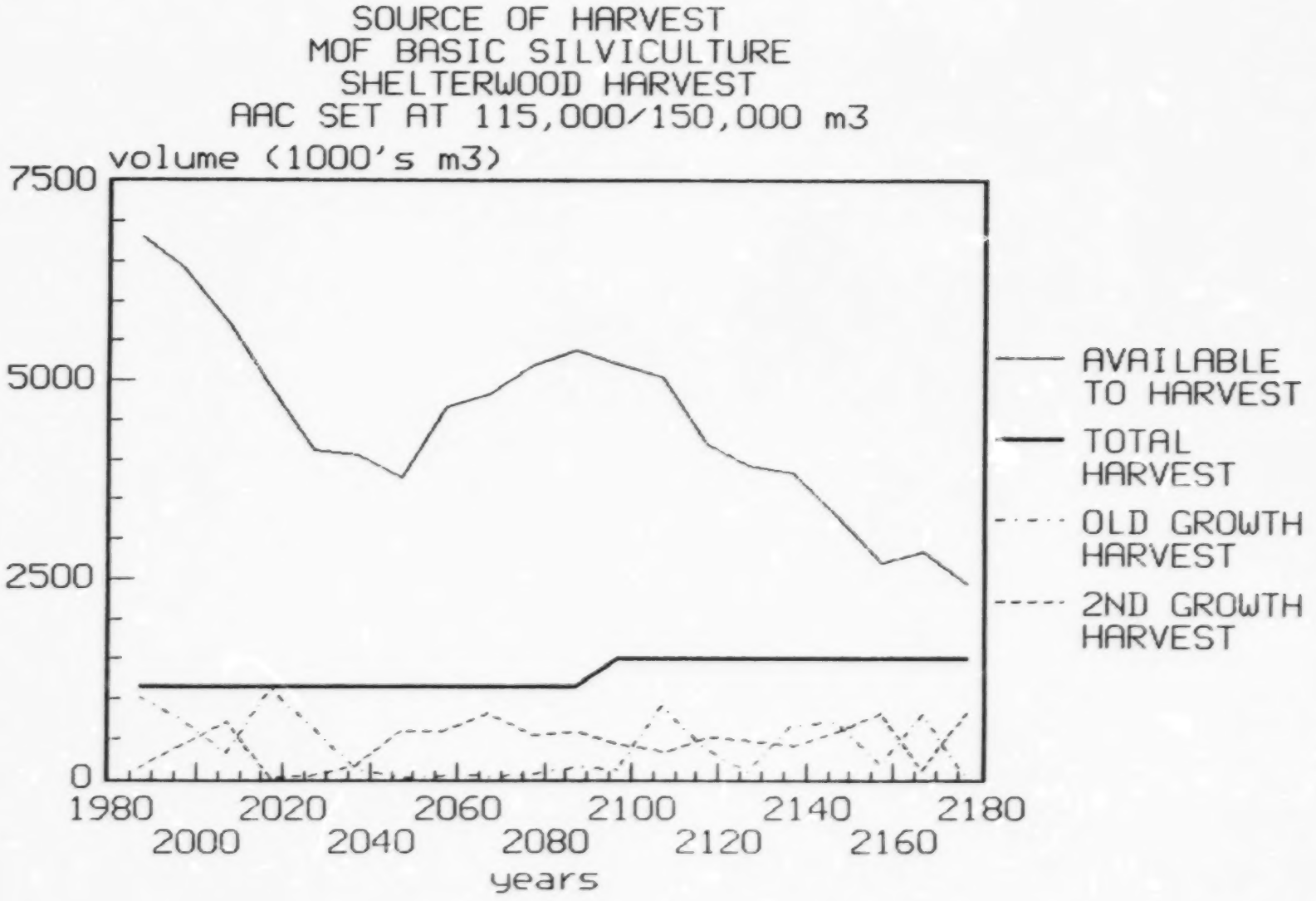

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
SELECTIVE SILVICULTURE YIELDS
LOW UTILIZATION
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

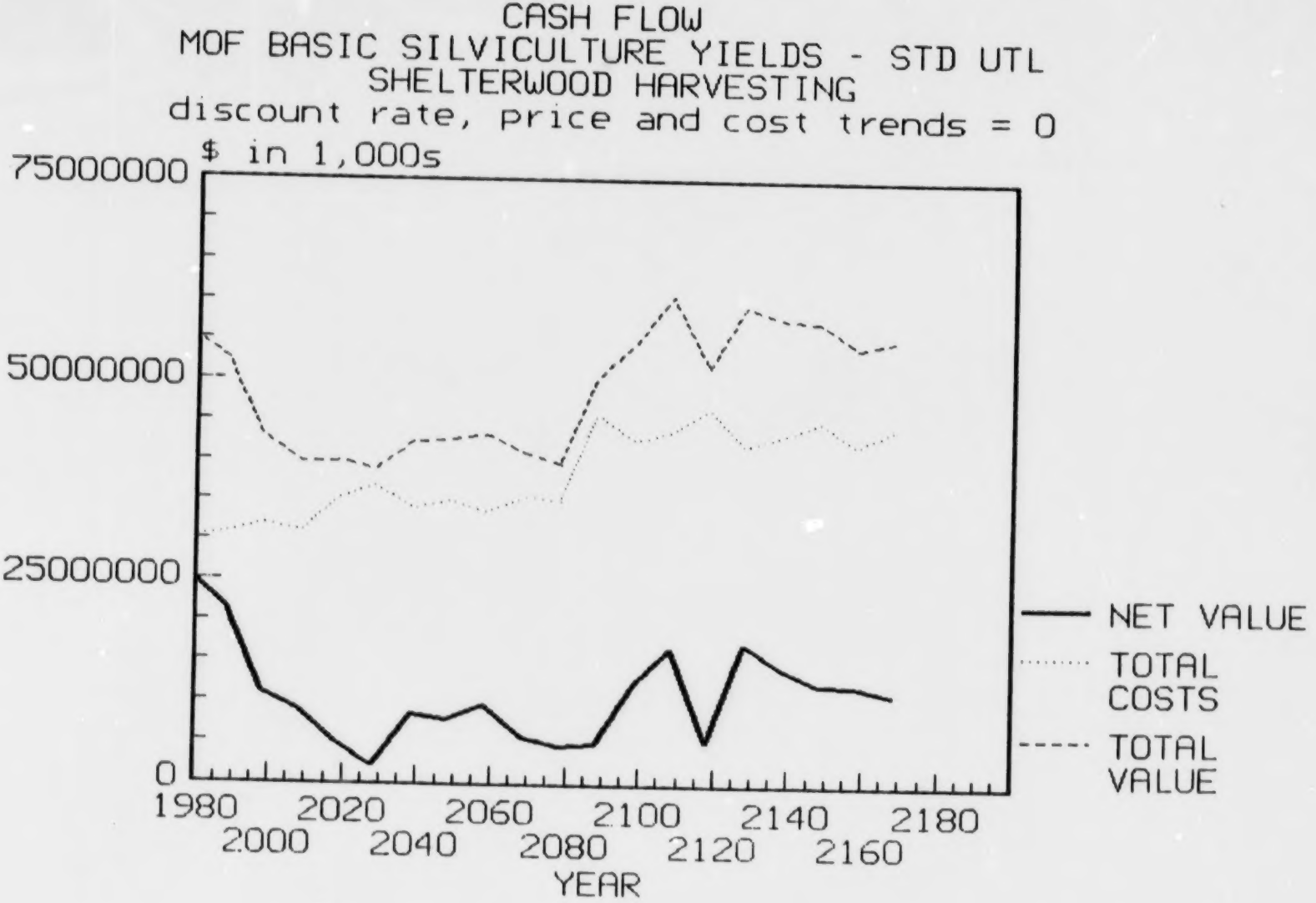

SOURCE OF HARVEST
MOF BASIC SILVICULTURE - STANDARD UTIL.
LONG ROTATIONS
AAC SET AT 80,000/100,000 m3
volume (1000's m3)
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

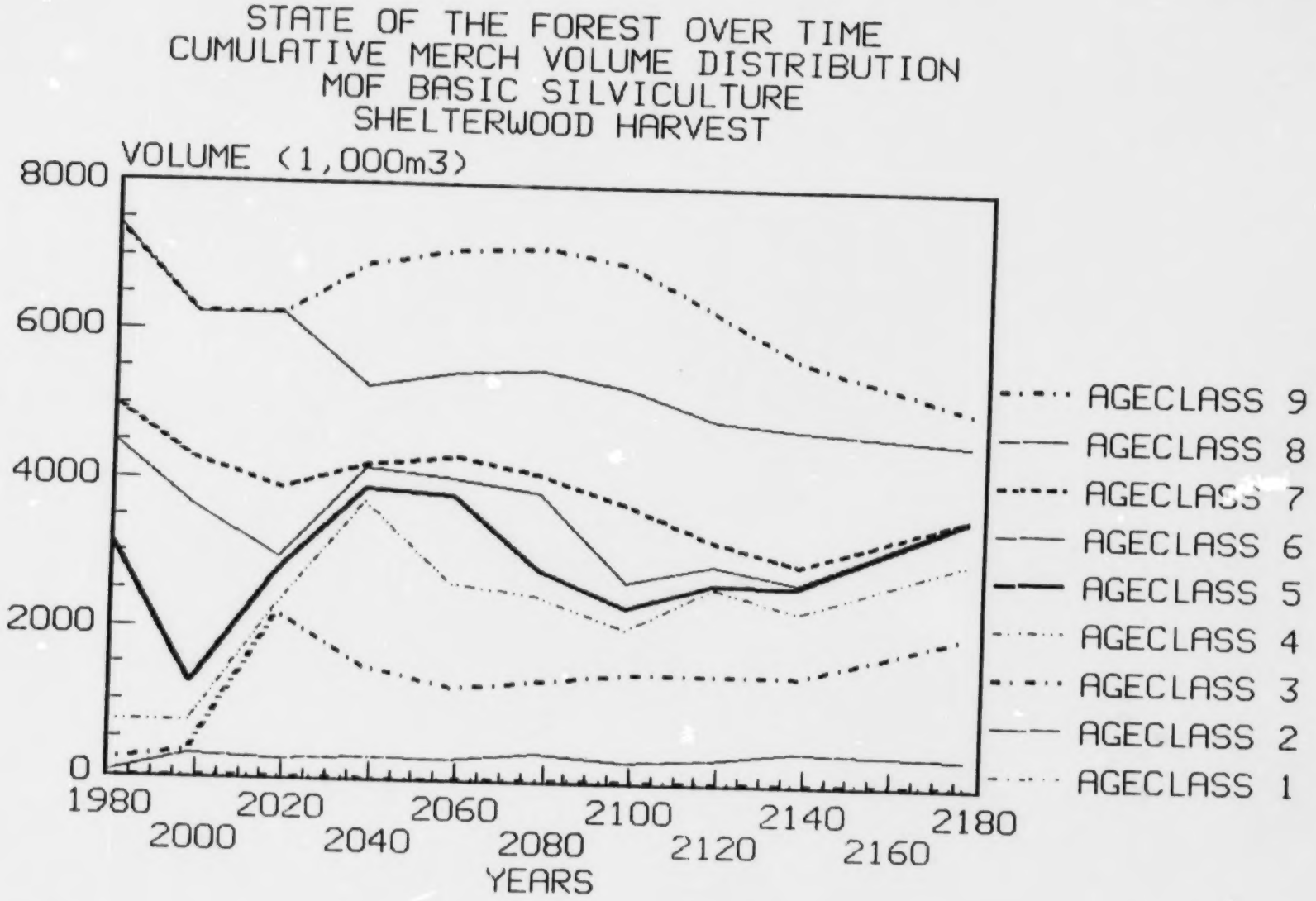

CASH FLOW
MOF BASIC SILVICULTURE YIELDS - LONG ROT
AAC SET AT 80,000 m3 THEN 100,000 m3
discount rate, price and cost trends = 0
$ in 1,000s
60000
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

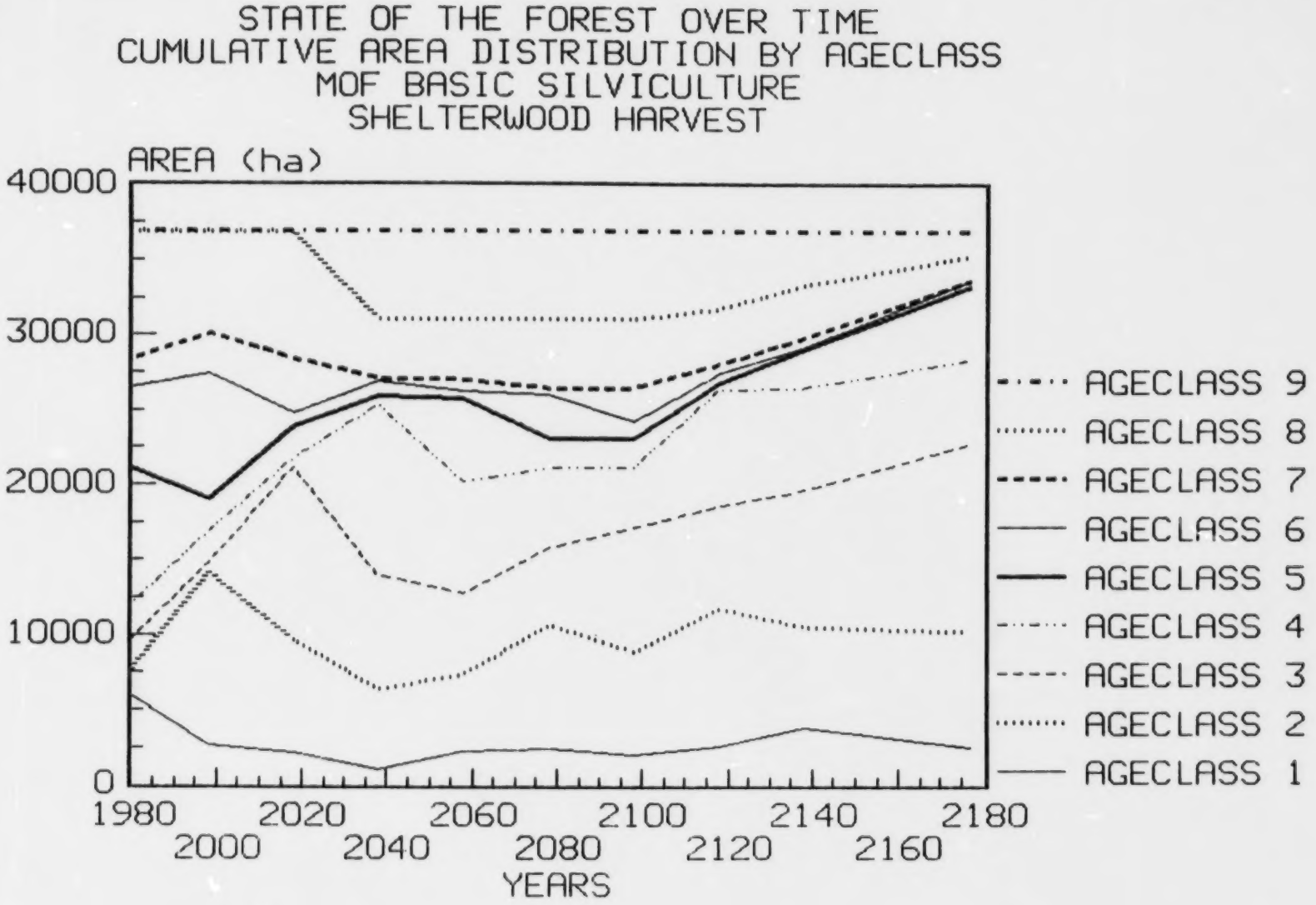

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE
STANDARD UTILIZATION / LONG ROTATIONS
VOLUME (1,000m3)
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

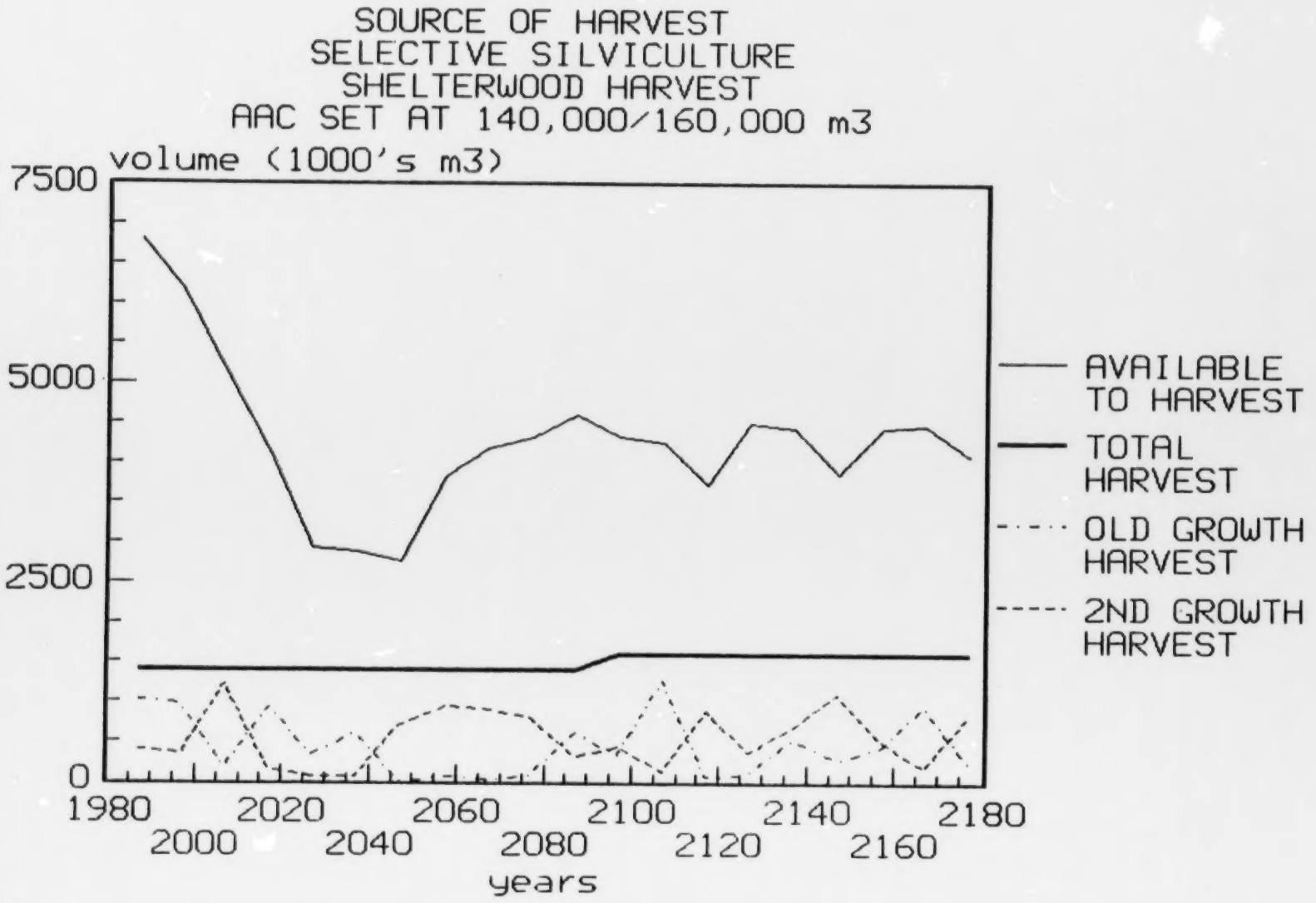

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE
STANDARD UTILIZATION / LONG ROTATIONS
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

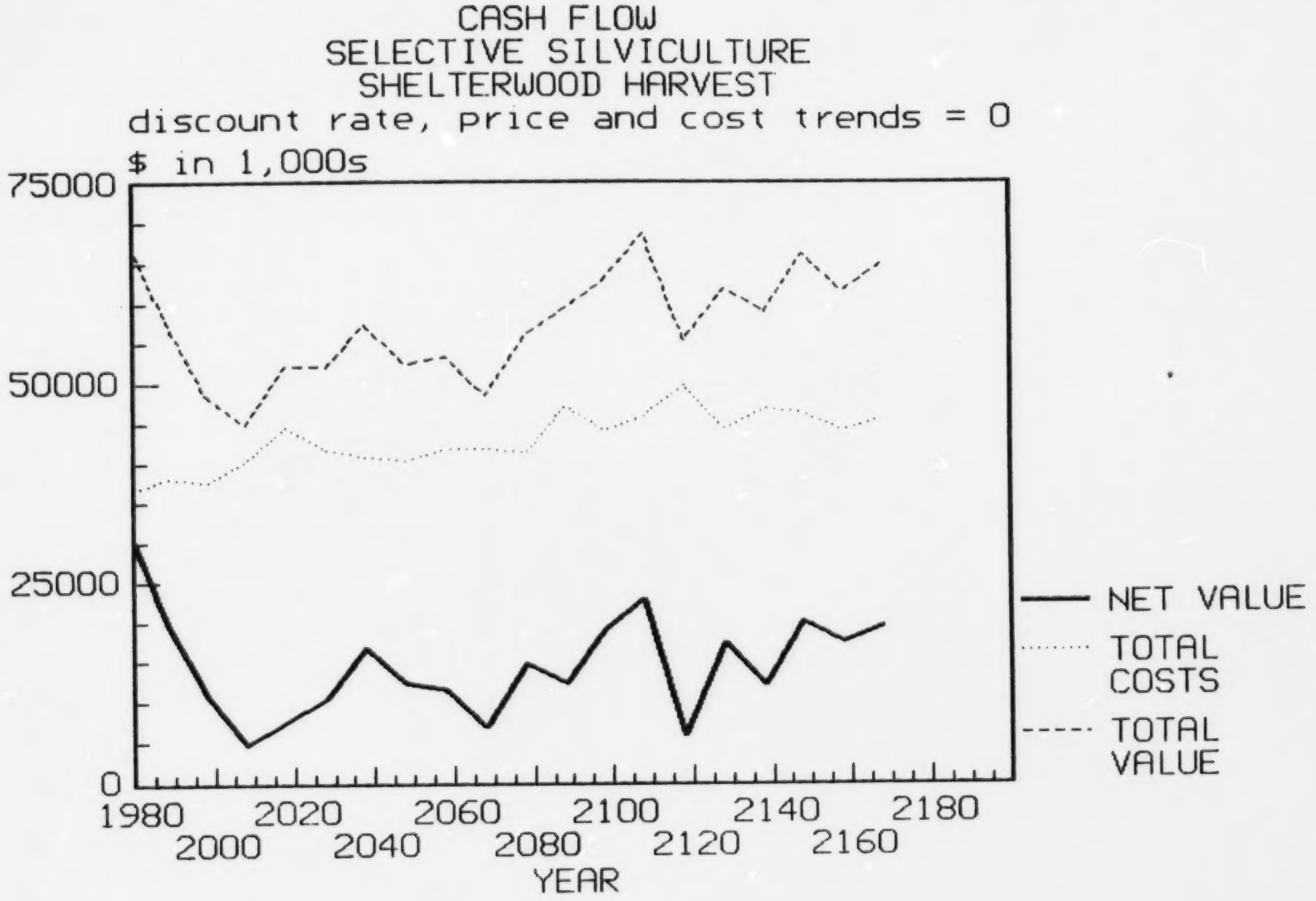

SOURCE OF HARVEST
MOF BASIC SILVICULTURE
SHELTERWOOD HARVEST
AAC SET AT 115,000/150,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

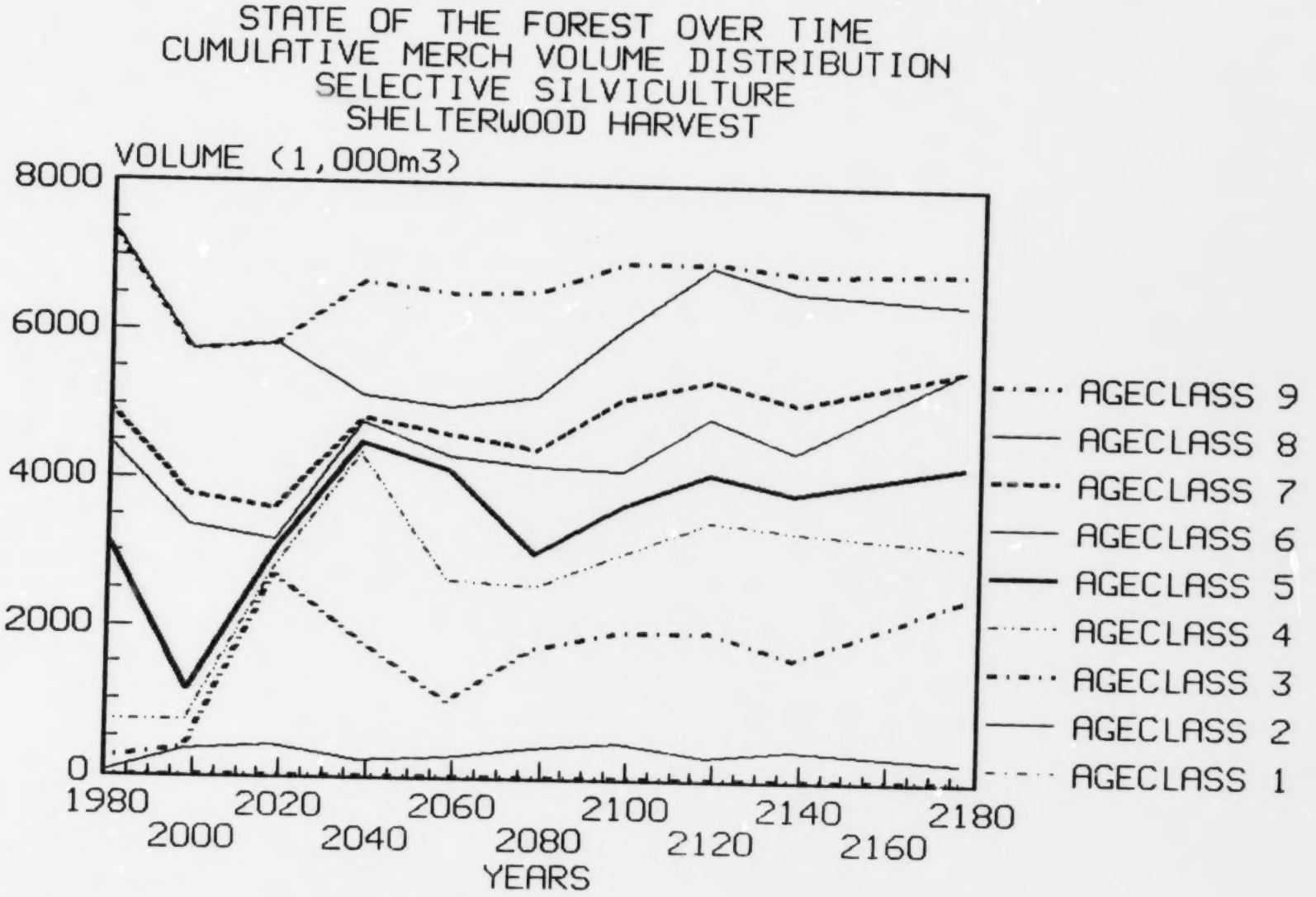

CASH FLOW
MOF BASIC SILVICULTURE YIELDS - STD UTL
SHELTERWOOD HARVESTING
discount rate, price and cost trends = 0
$ in 1,000s
75000000
50000000
25000000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

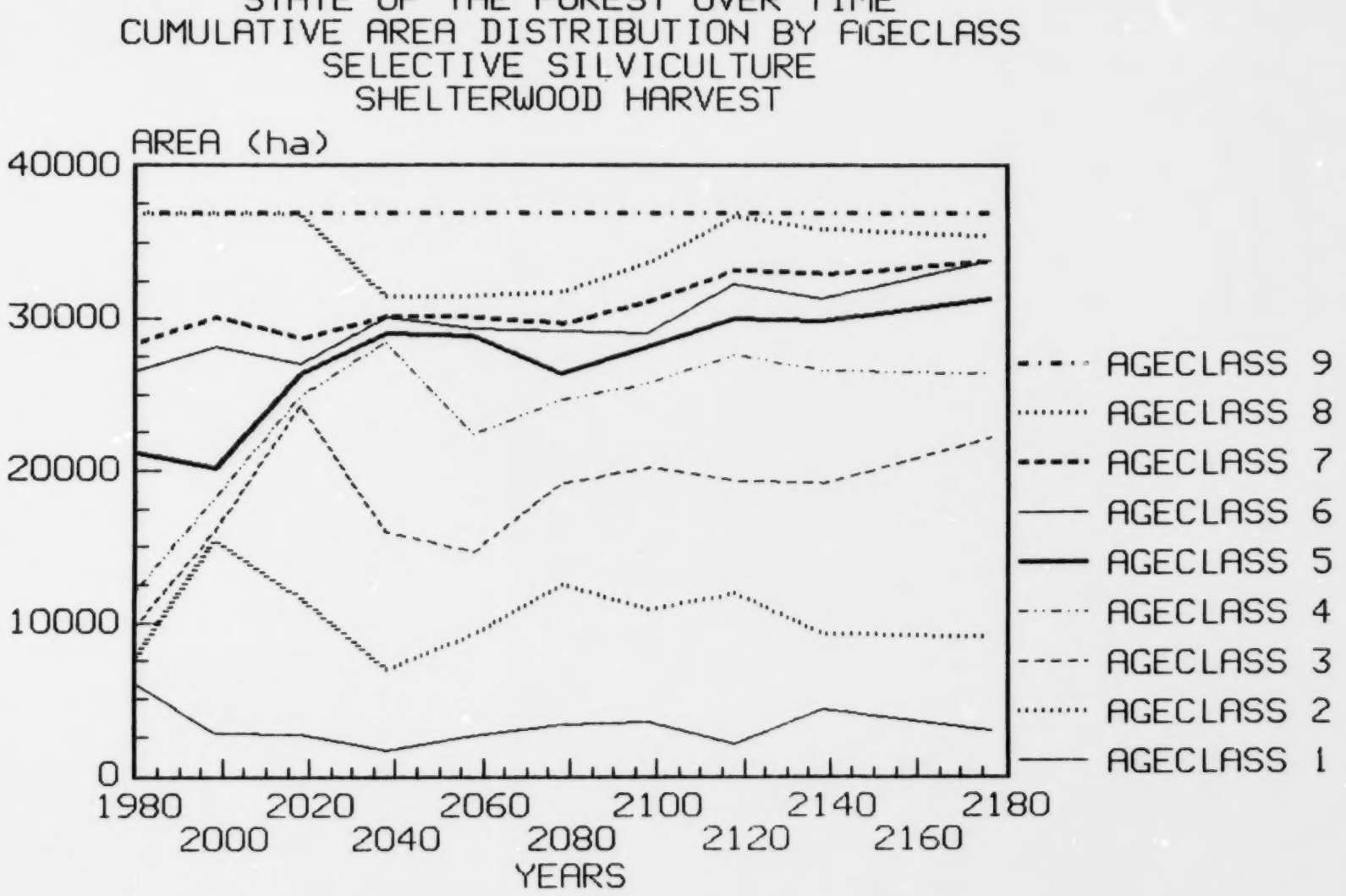

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE
SHELTERWOOD HARVEST
VOLUME (1,000m3)
8000
6000
4000
2000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

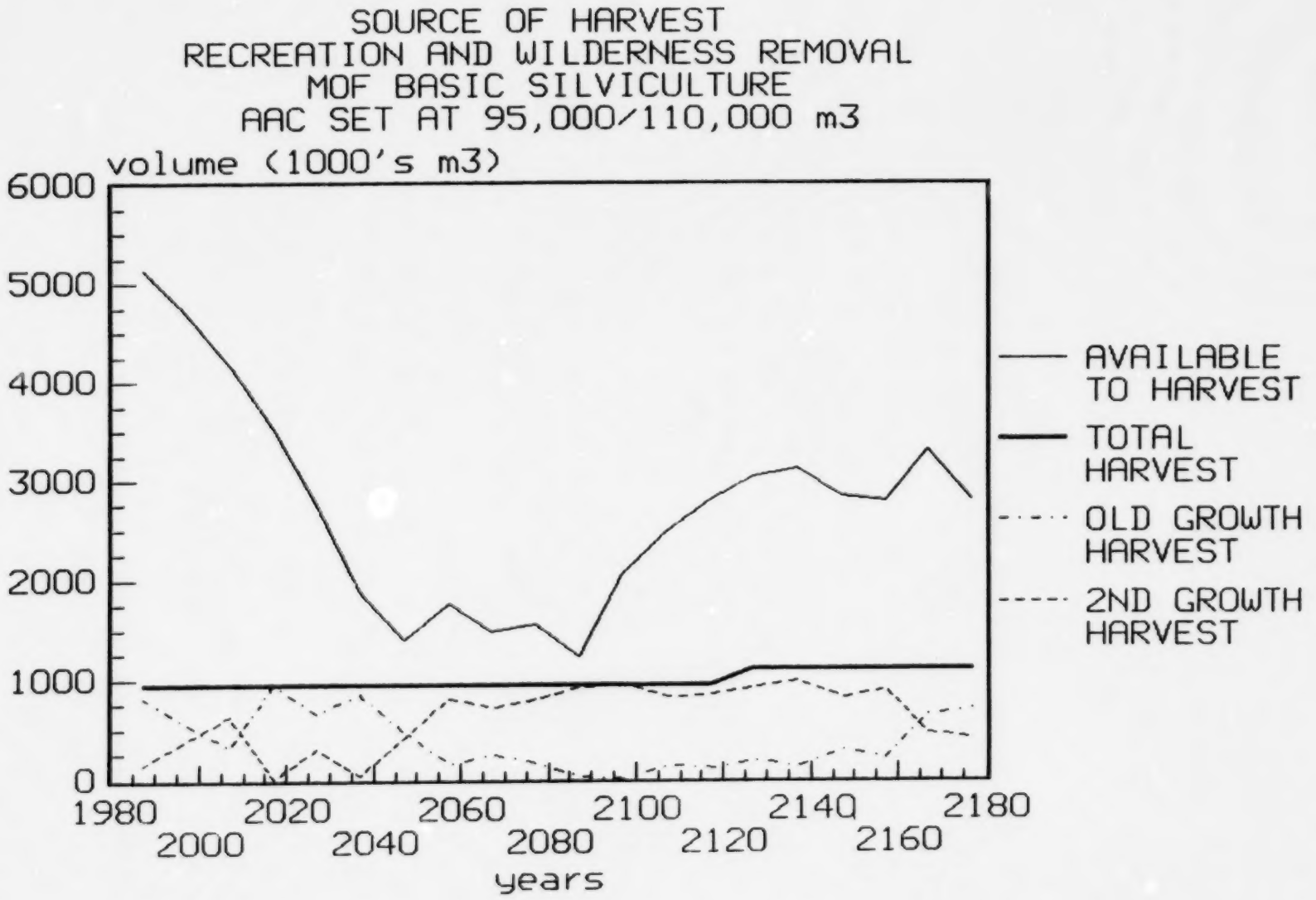

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE
SHELTERWOOD HARVEST
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

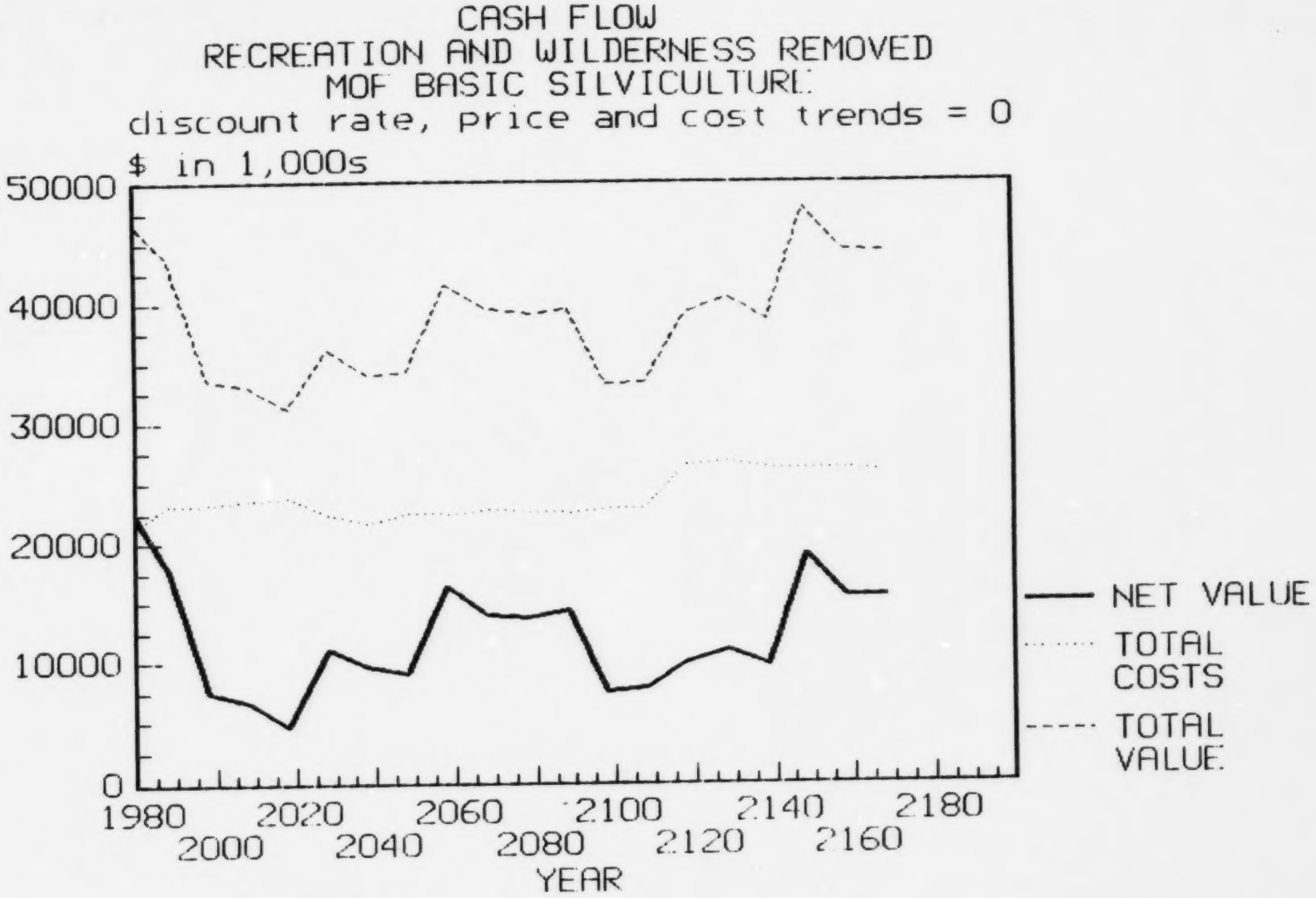

SOURCE OF HARVEST
SELECTIVE SILVICULTURE
SHELTERWOOD HARVEST
AAC SET AT 140,000/160,000 m3
volume (1000's m3)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

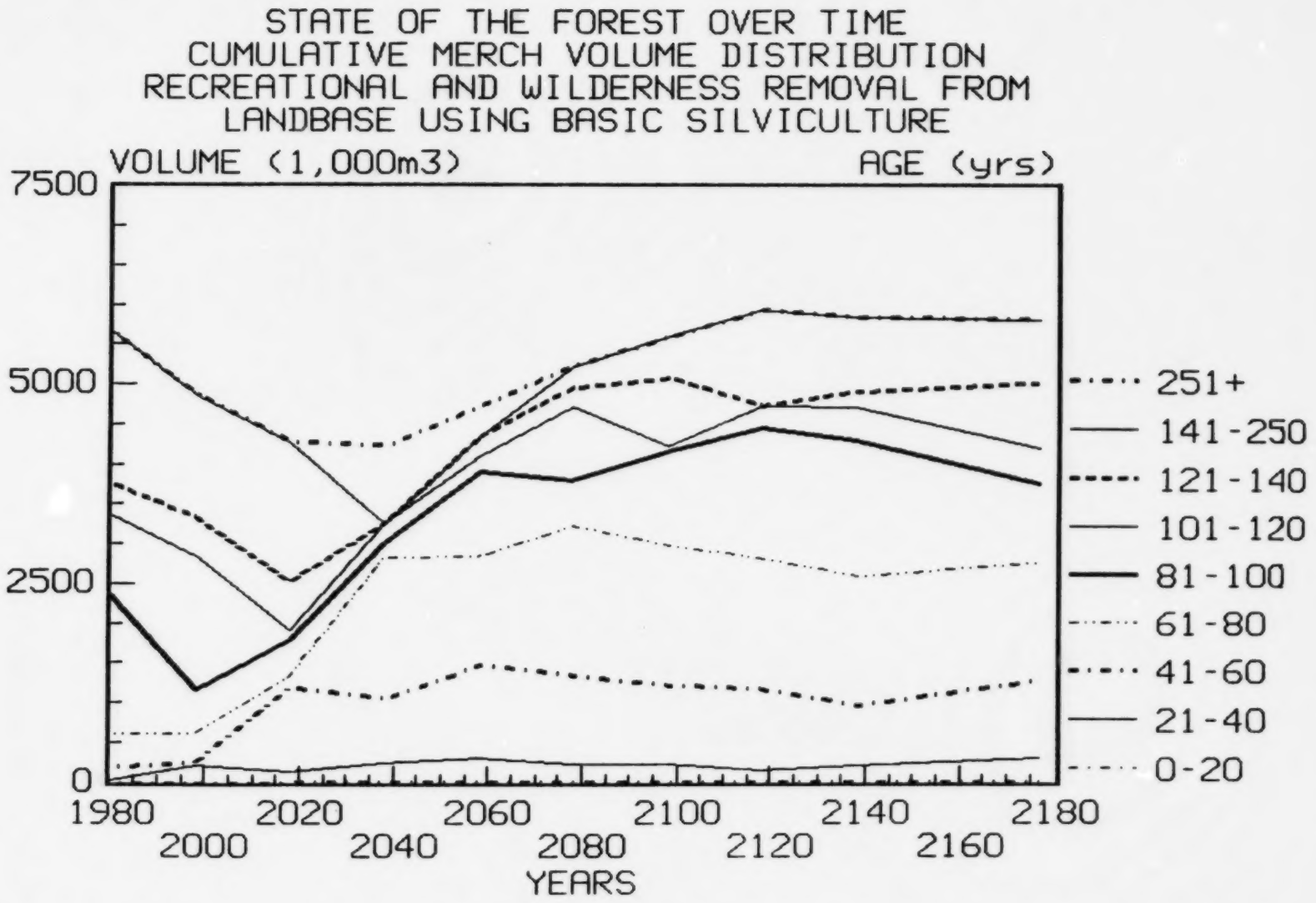

CASH FLOW
SELECTIVE SILVICULTURE
SHELTERWOOD HARVEST
discount rate, price and cost trends = 0
$ in 1,000s
75000
50000
25000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

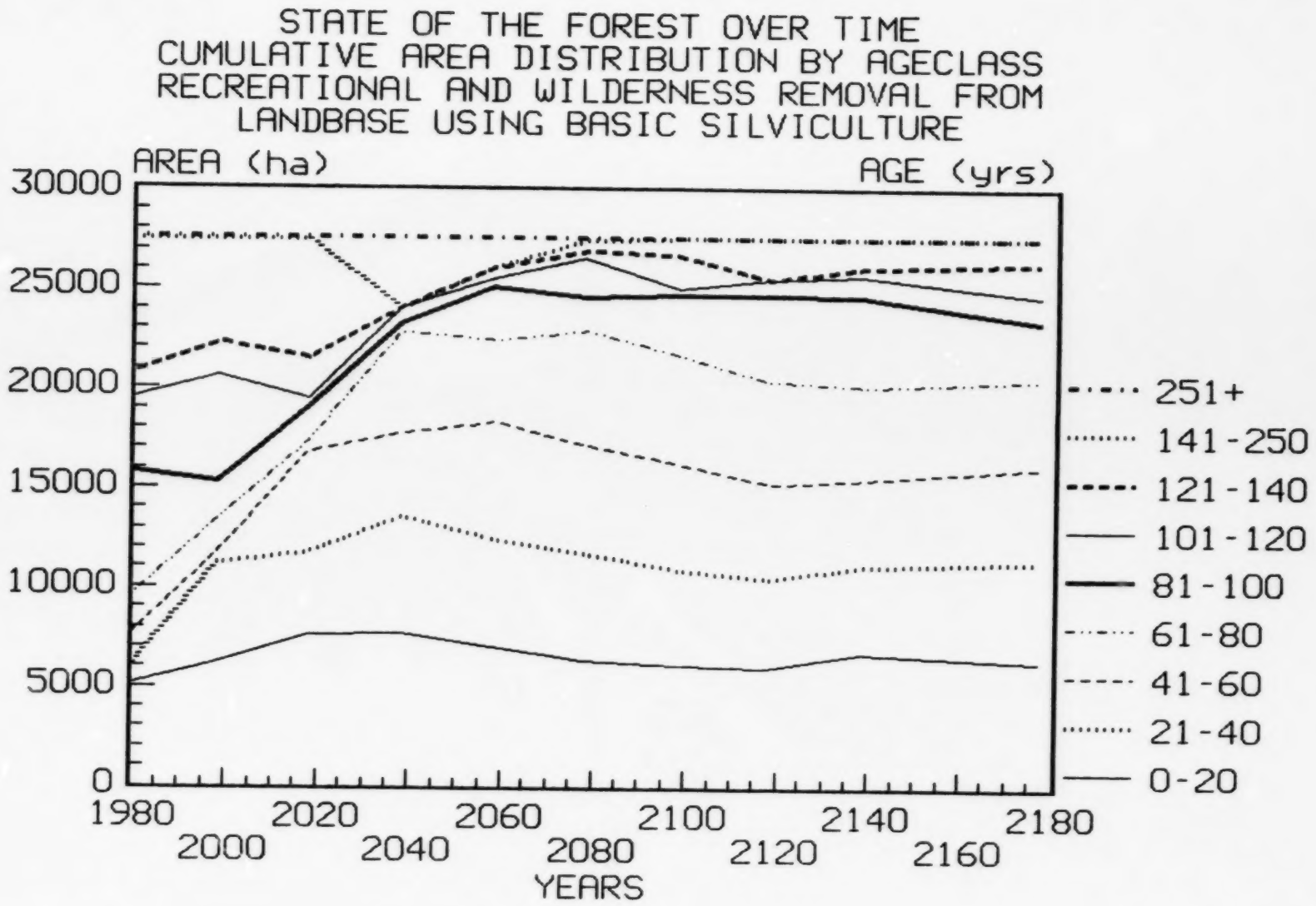

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
SELECTIVE SILVICULTURE
SHELTERWOOD HARVEST
VOLUME (1,000m3)
8000
6000
4000
2000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

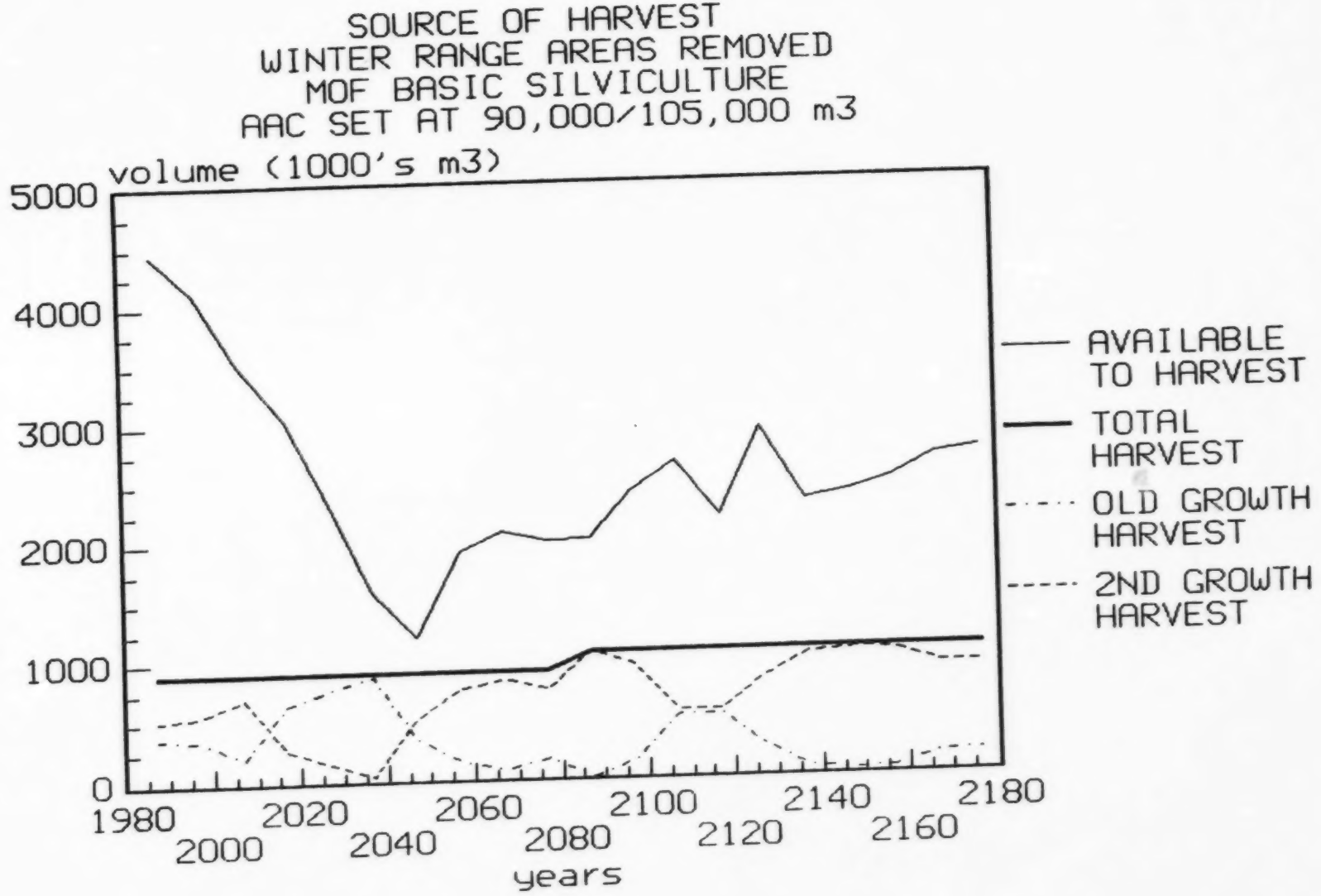

STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
SELECTIVE SILVICULTURE
SHELTERWOOD HARVEST
AREA (ha)
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

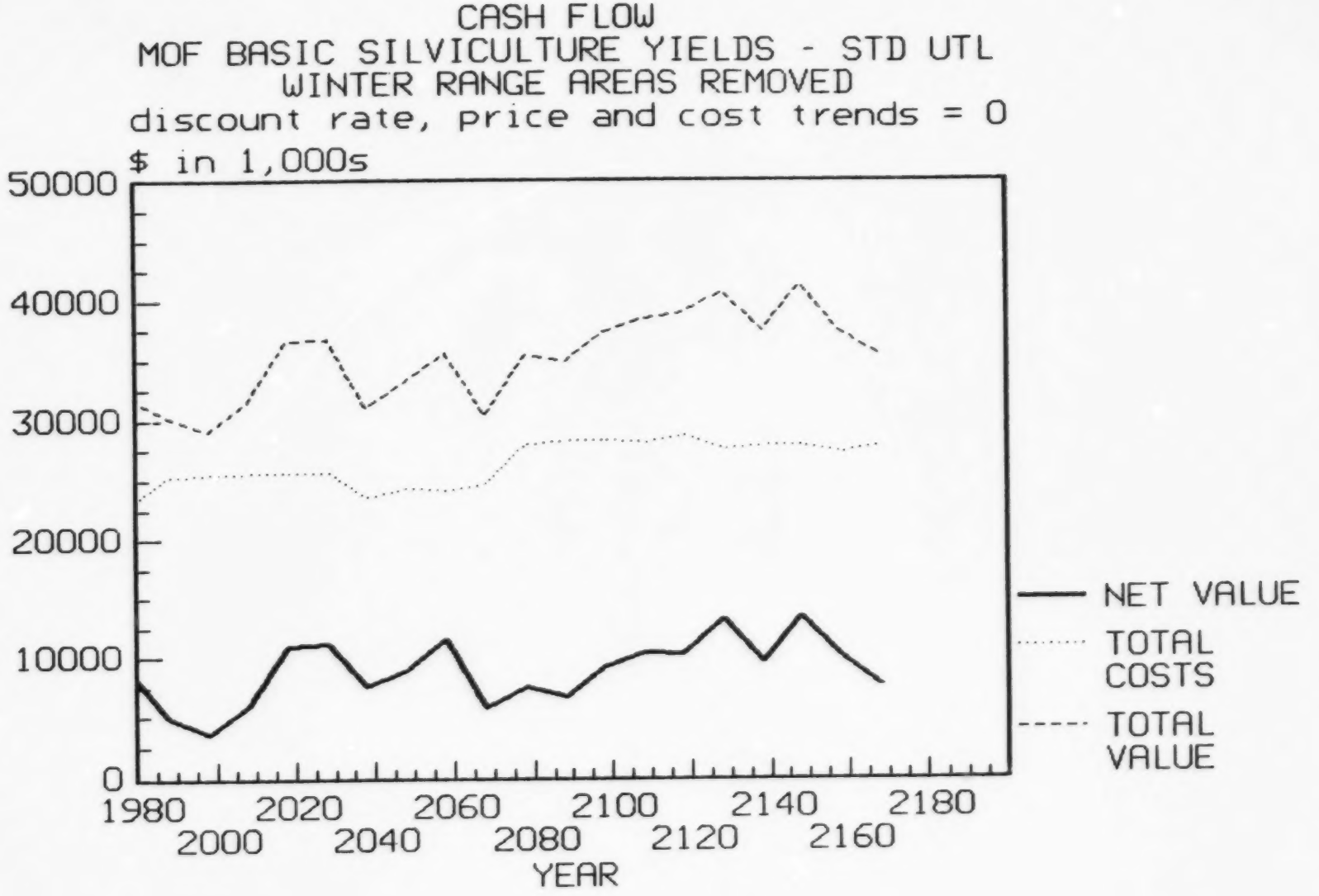

SOURCE OF HARVEST
RECREATION AND WILDERNESS REMOVAL
MOF BASIC SILVICULTURE
AAC SET AT 95,000/110,000 m3
volume (1000's m3)
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST

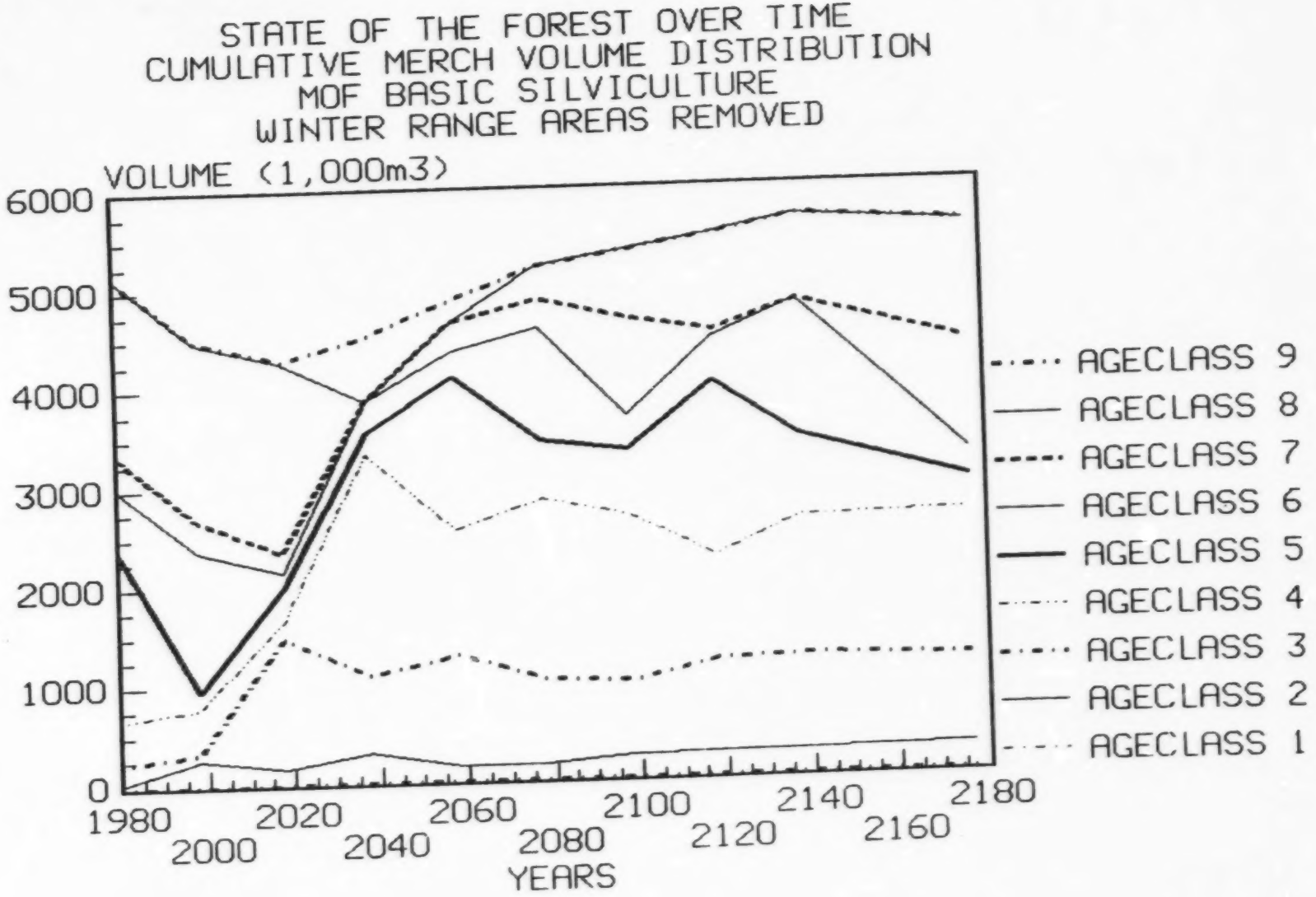

CASH FLOW
RECREATION AND WILDERNESS REMOVED
MOF BASIC SILVICULTURE
discount rate, price and cost trends = 0
$ in 1,000s
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE

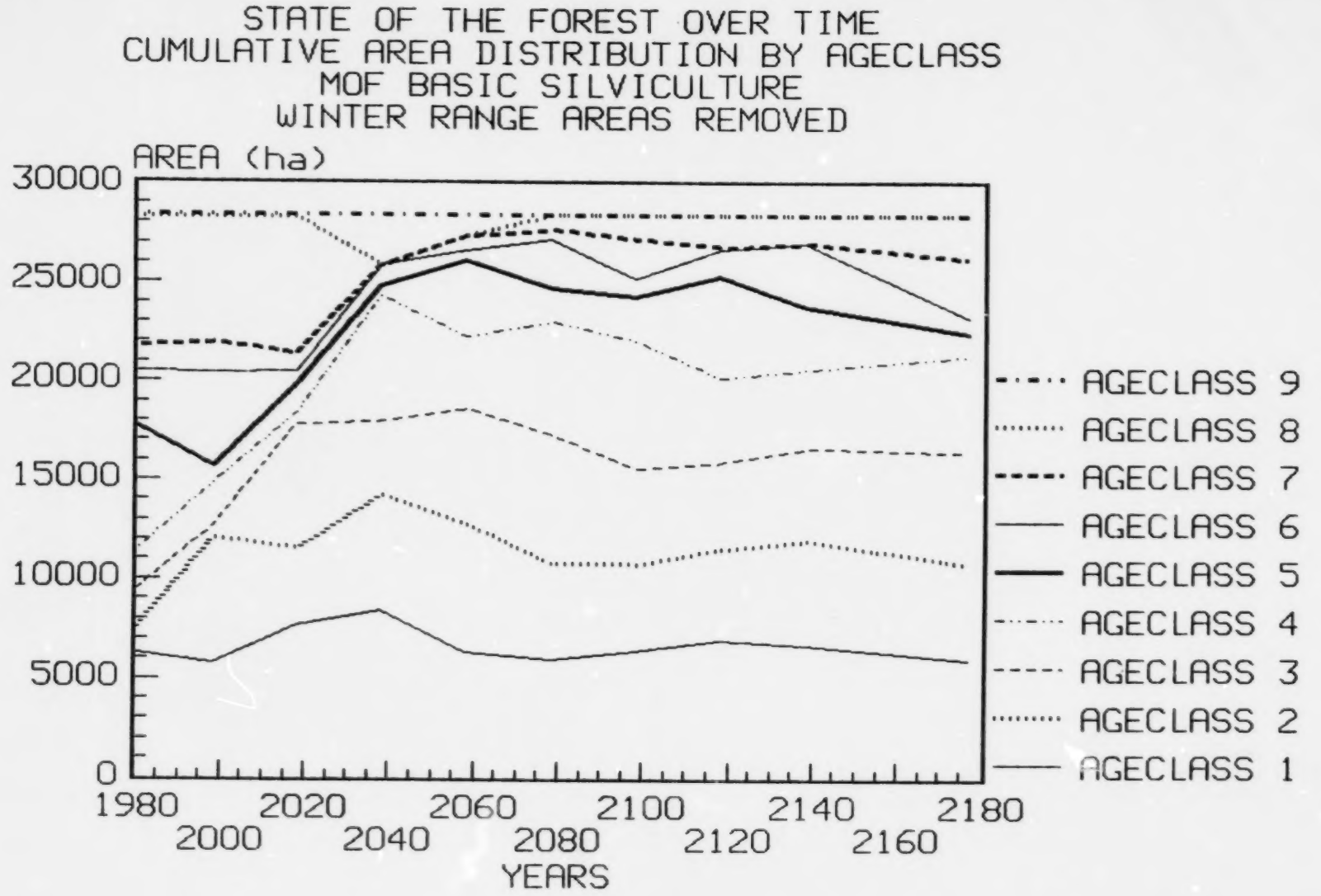

STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
RECREATIONAL AND WILDERNESS REMOVAL FROM
LANDBASE USING BASIC SILVICULTURE
VOLUME (1,000m3)
AGE (yrs)
7500
5000
2500
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20


STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
RECREATIONAL AND WILDERNESS REMOVAL FROM
LANDBASE USING BASIC SILVICULTURE
AREA (ha)
AGE (yrs)
30000
25000
20000
15000
10000
5000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
251+
141-250
121-140
101-120
81-100
61-80
41-60
21-40
0-20


SOURCE OF HARVEST
WINTER RANGE AREAS REMOVED
MOF BASIC SILVICULTURE
AAC SET AT 90,000/105,000 m3
volume (1000's m3)
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST


CASH FLOW
MOF BASIC SILVICULTURE YIELDS - STD UTL
WINTER RANGE AREAS REMOVED
discount rate, price and cost trends = 0
$ in 1,000s
50000
40000
30000
20000
10000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEAR
NET VALUE
TOTAL COSTS
TOTAL VALUE


STATE OF THE FOREST OVER TIME
CUMULATIVE MERCH VOLUME DISTRIBUTION
MOF BASIC SILVICULTURE
WINTER RANGE AREAS REMOVED
VOLUME (1,000m3)
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1


STATE OF THE FOREST OVER TIME
CUMULATIVE AREA DISTRIBUTION BY AGECLASS
MOF BASIC SILVICULTURE
WINTER RANGE AREAS REMOVED
AREA (ha)
30000
25000
20000
15000
10000
5000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
YEARS
AGECLASS 9
AGECLASS 8
AGECLASS 7
AGECLASS 6
AGECLASS 5
AGECLASS 4
AGECLASS 3
AGECLASS 2
AGECLASS 1

APPENDIX III

INCORPORATING NON-TIMBER VALUES IN FOREST MANAGEMENT

APPENDIX III

INCORPORATING NON-TIMBER VALUES IN FOREST MANAGEMENT

For the sake of brevity, we have kept discussion of non-timber values in the main body of the report brief and focused on indicators of those values. Much lies behind the indicators, and managing for non-timber values and trying to measure the results of that management is complex. This Appendix discusses some of the issues in management and valuation of non-timber resources in the forest estate.

1.0 WATER RESOURCES

Water is an important resource on and in the forest estate, and because it flows beyond estate boundaries, what happens to water in the estate is also important elsewhere. Water within the estate is in surface water bodies - streams and lakes - and also subsurface groundwater. In forest estate management the manager would be expected to take into account the value of the water resource and how it would be affected by other resource uses.

The most direct and easily recognizable impacts of resource uses on water are managed by regulation. Thus roads and culverts are designed to avoid interference with natural patterns of surface runoff; encroachment into water bodies is regulated for extractive activities; and the discharge of wastes into water bodies by those engaged in timber harvesting or recreation, etc., is controlled. These and similar restrictions are incorporated in management on a regulatory basis. Regulations are imposed without asking whether the costs associated with them (the costs of compliance) are equal to or greater than the corresponding benefits (damages prevented or reduced).

There will also be less direct effects of timber harvesting, livestock grazing and other resource uses on water quality and yields within the forest estate. The concerns over such effects vary significantly in different regions. In arid areas there has been much research into how vegetation removal can improve the timing of snowmelt. While vegetation management can't produce more water, it has been found that by affecting evaporation, sublimation and transpiration losses, it can alter the timing of runoffs and the amount of

water available for other purposes, as opposed to what would occur in an unmanaged or natural state.[1]

The relationships between timber management and water yields have been investigated for many years[2]. Not surprisingly the research indicates that generalizations across different sites are dangerous, as site specific factors have an extremely significant bearing on the outcomes of timber management practices.

Even if the physical relationships between timber management and water flows (or quality), were precisely understood, that would not remove the difficulties in incorporating the water resource in management objectives. The difficulty that remains is knowing what value to assign to changed states of the water resource. That is, if the water flows could be altered by a specific amount through vegetation management, at a cost of $X, is the change in the value of the water resource greater or less than $X?[3] We might know that a certain result **could** be achieved, but we still wouldn't know whether we **should** pursue that result.

These two generalizations define the problems that are encountered in trying to incorporate the water resource in explicit management objectives for the forest estate - an incomplete understanding of the effects of other resource uses on important aspects of the water resource, and no indications of the value of the water resource.

Given current regulations to protect surface water quality, there are no indications of problems within the forest estate

---

1. See Bowes, M.D. and J.V. Krutilla. 1989. Multiple-Use Management: The Economics of Public Forestlands. Chapter 5, Forest Management for Increased Timber and Water Yields. Published by Resources for the Future, Washington, D.C.

2. See for example: Kattelmann, R.C. 1982. Water Yield Improvement in the Sierra Nevada Snow Zone: 1912-1982, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station; Hewlett, J.D. 1982. Principles of Forest Hydrology, University of Georgia Press, Athens; Troendle, C.A. and C.F. Leaf. 1981. "Effects of Timber Harvest in the Snow Zone on Volume and Timing of Water Yield," in D. Baumgartner, ed., Interior West Watershed Management, Washington State University Cooperative Extension, Pullman.

3. Information on the value of water, or the way in which value is affected by changes in water quality or quantity is not available in British Columbia. Even in those areas of the world where some markets have developed, the observed prices are often constrained by administrative prohibitions, so that the true "value" of water is not readily determined. See: Frederick, K.D. ed. 1986. Scarce Water and Institutional Change, Resources for the Future, Washington, D.C., and Gibbons, D.C. 1986. The Economic Value of Water, Resources for the Future, Washington, D.C.

resulting from timber harvesting or other activities. Timber harvesting probably increases snow retention and the water available from snowmelt, and reduces losses from transpiration. Whether any increases in available water are significant is not known, nor is it known if they are beneficial or detrimental to other interests. That lack of knowledge, plus the inability to value the water in its present state, or in any altered state, means that we cannot effectively account for the relation between other uses of the forest and the water resource.

We have not, therefore, developed quantitative indicators for the water resource for inclusion in the accounts of the forest estate. That does not mean that the water resource would be ignored in forest management. Prohibitions on discharges of deleterious substances to water courses, and against encroachment into water courses, are an on-going part of management. If it was seen to be feasible, a program for monitoring water levels and quality in lakes, and flows and quality in streams could be incorporated in management responsibilities. These latter activities could be an integral part of fisheries management, and could also be integrated in other hydrological (the Water Survey of Canada) and water management programs (withdrawals of water as currently licensed by the Water Resources Branch of the Ministry of Environment).

Annual reporting for the water resource would in most cases have to be limited to physical measures dealing with quantity and quality. The reports could not be extended, as would be routine for the resources exploited on a commercial basis, to include accounting in monetary terms. Over time these reports would provide a means of identifying changes in the water resource. If changes became apparent specific management or research programs might be introduced in response, as deemed appropriate at the time.

2.0 RANGE FORAGE

Seasonal grazing by domestic livestock is an established use of the forest estate. It presently provides some 3,400 animal unit months (AUMs) of grazing for cattle owned by several local area ranches. Grazing opportunities of this type are an important input to the range livestock industry in B.C., which is dominated by beef cattle. Most ranches produce winter

feed on their deeded land, plus some spring and fall grazing, but also rely on Crown range in varying degree for spring, summer and fall grazing[4].

Livestock grazing makes only a modest financial contribution, in terms of direct revenue received in return for product consumed, to the forest estate. At the rate paid for grazing in 1990, $1.55 per AUM, the annual revenue from grazing would be some $5,270. The various management options for the forest estate which are analyzed in the pilot study reflect this current status of livestock grazing. We have not gone to great lengths to analyze alternatives for grazing, and none of the options contemplate grazing becoming a dominant use of the estate.

This level of attention does not reflect neglect or ignorance of the range forage resource and its use by livestock. Rather it reflects the level of grazing opportunities available within the estate, the fundamental economics of livestock grazing on Crown range in British Columbia, and some difficult areas of interaction between livestock and other uses of the forest estate - in particular forest regeneration and habitat requirements of wildlife.

It is probably not wise to refer to the range livestock industry, which has persisted for over 100 years in B.C. and will undoubtedly persist for another 100 years, as "uneconomic". But it is an industry in which the returns to labour and capital are considerably below what appears to be available in other sectors of the economy. Low returns to the factors of production employed in the range livestock industry are not a recent phenomenon. As Workman has stated: "Rates of return on investment in both cattle and sheep ranches have traditionally been low by non-ranching standards except, perhaps, during the short period in the 1880s when rates of return varied between 25 and 40 percent. Returns in recent years have commonly been in the neighbourhood of 2 percent."[5]

---

4. There are exceptions, of course, with some ranches able to meet all of their grazing requirements on deeded land. Access to Crown range is in two forms - by grazing permit for which charges are levied on an AUM basis by the Ministry of Forests, or under leases administered by the Ministry of Crown Lands.

5. Workman, J.P. 1986. Range Economics, MacMillan Publishing Company, New York. See also J.M. Fowler and L.A.Torrell. 1987. "Economic Conditions Influencing Ranch Profitability", Rangelands, 9(2), April. "... the net return on owned investment in 1978 with both small (100 AU) and medium (300 AU) sized cattle ranches was basically zero. Large (600 AU) cattle enterprises returned less than 1% (Gray, Fowler, Jones, 1981). A follow-up study ..... determined the net return on small ranches was adequate to cover cash expenses, but not enough to pay for depreciation, operator labour and management, and total capital (Gray and Fowler, 1983)."

These conditions prevail in B.C., as they do throughout the range livestock industry in North America. A current comment on B.C. conditions can be found in the conclusions of a panel discussion of farm financing in the 90's, hosted by the Nechako Valley Regional Cattlemen's Association, that an "... off the farm job is necessary if you are going to start farming or ranching today"[6]. That is a simple way of saying that the returns from ranching are not high enough to provide an adequate living for an operator and retire debt that may be incurred in order to enter the business.

The modest value of grazing opportunities reflects the economics of the range livestock industry. Under the formula presently used by the Ministry of Forests to establish the charge per AUM, charges have ranged from about $1.50 to $1.75 in recent years. It is generally thought that these charges don't capture the full value of grazing across the spectrum of available opportunities on Crown range in B.C. - which may range from $3 to $6 (and higher in some cases) per AUM.[7] The question of increased charges was an integral part of the Range Program Review recently conducted by the Ministry of Forests.[8] Opposition to proposals to increase grazing fees by the B.C. Cattlemen's Association was successful, and increases that had been proposed prior to the review were not implemented.

For the analysis in the pilot study the actual value of the grazing opportunities, which we have taken to be in the order of $6 per AUM, is used in the analysis of management options. Only a part of this value is captured by the grazing fee, which has been assumed to continue at a level of $1.55 per AUM, and is reflected in the direct payments to government. This corresponds to the approach in dealing with timber harvests, where the full "value created" is shown, but only a part is captured by the stumpage charges.

Whether actual fees paid or value created per AUM are used, scenarios in which grazing is a major focus of the forest estate are unlikely to demonstrate satisfactory economic performance. Not only are the values generated in grazing low, but if intensive management, fencing and water development are required, it is quite likely that the costs would exceed the added grazing value. It can be noted that the last major investment in range

---

6. As reported in Beef in B.C. magazine, May/June 1990.

7. Land Sense Ltd. and Clayton Resources Ltd. 1988. Review of Charges for Livestock Grazing on British Columbia Crown Ranges, report prepared for the Range Section, Integrated Resources Branch, Ministry of Forests, Victoria.

8. Ministry of Forests. 1989. Range Program Review, Final Report of the Task Force, Victoria, B.C.

infrastructure in B.C. required government funding, under an ARDSA agreement. The federal government provided 45 percent of the funding, 45 percent was provided by the provincial government, and the balance of 10 percent by range users under interest free loans. Without the government funding the investments could not have been made on the basis of the value of the enhanced grazing opportunities, or the ranchers' ability to pay.

Beyond the direct economic returns that can be realized from grazing per se, two other areas of concern arise from the relationships between livestock grazing and other uses of the forest, relationships which affect the overall economic returns from grazing in integrated forest resource management. These concerns are first, the interactions between grazing and forest regeneration, and second, competition between domestic livestock and wildlife for available forage resources.

The interaction between cattle and forest regeneration is complex. There are concerns that cattle damage seedlings and impair regeneration, there is also evidence that properly managed grazing by cattle and sheep may benefit seedlings by reducing competition from other plants. Some important practical research in this area was conducted on a large private forest holding in Oregon[9]. Studies on this forest have indicated that livestock grazing and forest regeneration are compatible, and may in fact enhance each other. But, for these results to be attained, it was found that the distribution of cattle was critical and required intensive management: "Ranchers were required to have full time riders maintaining distribution."

Because it is uncertain whether the grazing value can support the added costs of intensive management that we are reluctant to embrace an assumption that the forest estate can support a significant increase in grazing, or that an increase could be achieved without impacts on forest regeneration. In that regard we note preliminary results from one B.C. study of the interaction between grazing and silviculture which indicates damage to seedlings ranging from 20% to 70% of the trees (average 38%)[10]. That study also indicated that careful management of cattle was necessary, and that the level of management required for integrated use could be different than for single use range purposes. We also note that forest companies have made various proposals to government that a fund should be established to

9. See "An Answer to the Forestry/Grazing Face-Off", Beef in B.C. magazine, July 1986.

10. "Silviculture/Cattle Interaction Update", in Beef in B.C. magazine, March/April 1990.

deal with damage to new forest plantations resulting from range use, and that a Grazing/Silviculture Working Group within the Ministry of Forests has issued a report dealing with means of resolving the question of liability for damage. All of this suggests that simple assumptions regarding expanded grazing on the forest estate would be inappropriate for the pilot study.

The other concern that bears on domestic livestock grazing within the forest estate is the possibility of competition with wildlife for available forage resources. It is generally held that at some levels of stocking wildlife and domestic livestock can be complementary, while beyond certain levels they become competitive. Examples of both situations can be found in British Columbia, and in the western United States.[11]

Given a desire to integrate various uses of the forest estate, and to make necessary tradeoffs to arrive at a pattern of "optimal" use, some principles for allocating forage resources between users have been developed. Their implementation requires knowledge of the respective values from different uses, and the relationship between those uses.[12] Figure 1 indicates how an optimum combination of cattle and elk AUMs can be determined.

The solid curve ABOC represents the relationship between cattle and elk use of a range. Between points A and B on the curve, the two uses are complementary; the influence of cattle on vegetation is such that the carrying capacity for elk is increased. Between points B and C the relationship is competitive; as cattle use of forage increases, the carrying capacity for elk decreases. Since any point on the curve can be achieved, selecting the combination of cattle and elk that generates "optimum benefits" requires information on the respective values. In the figure, this is represented by the line FG, the slope of which indicates a value of $6 per AUM for cattle use of forage and $9 per AUM for elk forage. At point O, where this line is tangent to the production possibilities curve, ABOC, the net value of the forage will be maximized. In the figure, the optimum combination is about 125 cattle AUM and 140 elk AUM.

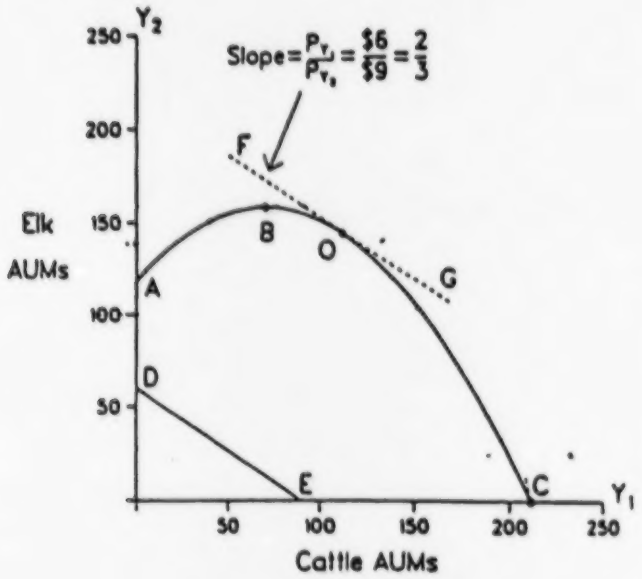
---

11. Day, A. 1987. "Proper Grazing Can Save the West", Rangelands 9(1), 21-22; Nielson, D.B. et al. 1986. "Big-game Animals on Private Range", Rangelands 8(1), 36-38; Land Sense Ltd. & Clayton Resources Ltd. 1988. Review of Charges for Livestock Grazing on British Columbia Crown Ranges, Ministry of Forests, Victoria.

12. Pearse, P.H. 1969. "Toward a Theory of Multiple Use: The Case of Recreation Versus Agriculture", Natural Resources Journal, 9, 561-575. Workman, J.P. 1986. Range Economics, MacMillan Publishing Company, New York.

FIGURE 1

OPTIMUM COMBINATION OF TWO COMPLEMENTARY PRODUCTS*



* Workman, Range Economics, 1985.

While this indicates that the principles for "optimal management" can be laid out with apparent precision, there is relatively little knowledge of the shape of the curve ABOC for most British Columbia forage resources. In addition there is a poor understanding of the values which determine the slope of the FG line. This lack of knowledge again leads us to be cautious about making simple assumptions regarding livestock grazing within the forest estate and portraying increased levels of grazing use as though it were a feasible management alternative.

This discussion indicates our reasons for not taking an aggressive approach to grazing in developing the pilot study management options. In actual management of the forest estate the question of how to most effectively integrate livestock grazing with other forest uses

could be addressed in more detail. It is possible that an increase in grazing would be found to be desirable, given knowledge about the several important interrelationships. Even with a significant increase, however, we anticipate that livestock grazing would continue to be a complement or supplement to other dominant uses of the estate, and feel that the level at which it is represented in the pilot study adequately reflects its potential role.

3.0 WILDLIFE RESOURCES

The forest estate supports a typical endowment of wildlife for the interior of British Columbia. Moose and deer represent the large ungulates; elk and caribou do not occur presently in the estate although there is a potential for them. Upland game birds include blue grouse, Franklin's grouse and ruffed grouse. Migratory waterfowl nesting on wetlands in the estate include ducks and geese. Black bears and coyotes are "normally" abundant within the estate, and wolves may be present occasionally. Other species of note include squirrels, pine marten, mink, and beaver - sometimes considered as furbearers.

Wildlife management has traditionally consisted mainly of the regulation of the consumptive uses of the species mentioned above through recreational hunting, trapping and predator control activities. The estate supports a much wider spectrum of vertebrate and invertebrate fauna, as well, although inventories of these species have not been undertaken.

Rough population estimates indicate that some 235 moose and 160 deer are supported by the estate under present levels of wildlife and forest management. The estate is believed to be capable of supporting about twice the present numbers of these species, or some 470 moose and 320 deer, and also some 50 elk. The major factor limiting the capacity of the estate to support these species is believed to the extent of habitat which is suitable as "winter range". Habitat that can be used during spring, summer and fall is generally capable of supporting more animals than the winter range, hence the winter range becomes the limiting factor which determines the capacity of the entire estate.

The population estimates indicate that in managing wildlife within the forest estate, there is a fairly wide range of "output" that could be attained. The potential is there to double the major ungulate populations, and this could probably be attained through a combination of management practices. More intense direct management of moose and deer - more sophisticated hunting harvests and better control of illegal harvests - would probably result

in considerable population increases. And management of habitats - regulating competition for forage with domestic livestock, preserving and enhancing winter ranges - may also contribute to raising populations to the indicated potential of double present levels (to approximately 470 moose and 320 deer).

As for any other product of the forest, some guidance as to its "value" is needed in order to decide how much of it to "produce" and at what costs - in terms of both the cost of direct management activities and loss of other resource uses (as per the cattle/elk tradeoff indicated above in Figure 1). In some cases efforts have been made to value individual animals themselves, although it is more common to try to value the wildlife populations indirectly through the various uses which they support - recreational hunting, hunting for subsistence or food, and fur harvests or trapping.

For the major wildlife species in the forest estate the dominant use is recreational hunting, and to a much lesser extent wildlife observation as part of a non-consumptive experiences such as camping or sightseeing. The methods for valuing these forms of recreation are discussed subsequently in the context of recreational activity in the forest estate generally. The values realized from subsistence hunting and fur harvests are very modest, and are not dealt with explicitly in any of the pilot study management options. It is also recognized that there are "non-use" values associated with wildlife species in the forest estate, insofar as it is important to some people that these populations exist even though they will not directly visit the estate to either observe them or hunt for them. These "non-use" values are discussed elsewhere in this Appendix.

While the estimates of the forest estate's potential to support moose and deer populations are believed to be quite realistic, they represent one limit to the range of possibilities. At the other limit would be populations below those presently supported by the forest estate. Unfortunately, we don't have the estate specific knowledge that would let us relate various levels of wildlife management input to discrete population levels within the range of possibilities. This limitation applies to both the interactions between wildlife and domestic livestock, as discussed above, and also to the relation between timber harvesting practices and wildlife. It is generally accepted that timber harvesting is reasonably compatible with moose or deer in areas that are used for summer ranges, but that this compatibility may not extend to winter ranges.

The various timber management options have been reviewed in this regard, and for most of them the differences with respect to probable impacts on wildlife abundance are not sufficient to support projections of changes in wildlife abundance. Therefore for the "timber driven" options (1 to 8) that have been considered, we have not projected any changes in present wildlife populations and recreation supported on the forest estate. Modest changes occur with the shelterwood harvest options (9 and 10). One major option, Option 12, where the emphasis is on wildlife and timber harvesting practices are modified substantially, has been introduced to demonstrate the kinds of changes that might be possible. It is believed that this level of modelling is adequate to the pilot study, and that attempting to be more sophisticated would only be misleading. With more careful during the course of estate management, and better information, the management options could no doubt be delineated much more precisely.

4.0 Fish Resources

Incorporating fish resources in planning the management of the forest estate involves issues similar to those for wildlife. Native fish species are resident in the streams and lakes of the forest estate and are known to support some sport fishing. In addition, because the streams of the estate are part of the Thompson River system, they may provide spawning and rearing habitat for anadromous salmon and steelhead. If so, then through such fish stocks the estate's waterways could contribute to commercial, sport and subsistence fishing in distant areas. We do not have estimates of sport fish populations resident within the estate, as it is not the custom of fisheries managers to make such estimates.

With respect to the relations between fish abundance and the different timber harvesting options, little is known. It is generally the case that with modern logging techniques and approaches to harvest planning there is little direct impact on fish[13]. For this reason we

13. For some time now the available evidence has indicated that declines and/or persistent low population levels in many fish stocks are more likely to be the result of over-fishing than habitat degradation. This has frequently been demonstrated by the recovery of many significant salmon stocks in response to reduced harvests, habitat conditions remaining constant.

    See for example, Vernon, E.H. 1982. Fraser River Sockeye: The Stocks and Their Enhancement. Department of Fisheries and Oceans, Vancouver. "... it is judged that well over 90 percent of the original Fraser River capacity to produce sockeye remains intact today." (p.18); North Pacific International Chapter of the American Fisheries Society. 1981. Submission to the Commission on Pacific Fisheries Policy. "... our professional opinion based on extensive observations in salmon and steelhead streams in recent years is that the principal

see little basis for postulating that there would be significant or measurable direct impacts on the fish or on fishing as a result of carrying out timber harvests on the estate. Thus for the "timber driven" options that are considered we do not project changes in fish abundance or in fishing on the forest estate.

Timber harvests could indirectly affect fishing, even in the absence of direct impacts on fish, however. Indirect impacts could be of two types, the first through provision of access, the second through impairment of visual amenity.

It is frequently the case that improved access to fish stocks, provided via logging roads, can lead to heavy fishing pressure and harvests in excess of sustainable levels. In the absence of proper regulation of fishing effort there can ultimately be a loss of recreational opportunity. Since the forest estate we are dealing with is already "roaded" and its fisheries are accessible to fishermen, any such impacts (to the extent that they have not already occurred) will be neutral as between the alternative approaches to timber harvests. Accordingly we have not accounted for such impacts in the forest management modelling.

The second potential for an indirect effect of timber harvesting on sport fishing may arise through impairment of the visual amenity of the estate. This could affect those fishing within the estate, although such fishermen frequently accept the visual impairment of timber harvesting and logging roads as a tradeoff for the access they gain. Such effects can spread beyond the estate boundaries, and, as in the particular case of the estate adopted for the pilot study, affect fishing in adjacent areas. Operators of sport fishing lodges on lakes adjacent to the pilot study forest have argued that logging within their "viewshed" will adversely affect the quality of their clients' fishing experiences.

This is responded to in Option 11, where a substantial area of the forest estate is withdrawn from timber harvesting. This has the effect of protecting the viewshed and also generates other recreational benefits within the estate from use of the land withdrawn from logging. The analysis is able to demonstrate the impact this has on the values realized through timber harvesting. It is not clear, however, that this will produce a quantifiable benefit for the neighbouring sport fishing lodges. We don't know if what their clients are willing to pay

reason for declining abundance has often been overfishing. In spite of logging and other insults to some watercourses there currently exist many miles of excellent stream habitat practically unoccupied by juvenile salmon and steelhead as a result of insufficient spawning escapement." (p.2)

would decline if logging were to proceed in those areas, or if fewer clients would fish from the lodges, and experience in other areas provides little useful guidance. Thus the analysis of this option does not assume a response in terms of value generated in these "outside the estate" sport fishing opportunities. This would clearly have to be analyzed more carefully, along with the other recreational implications of the management option, before it could be adopted. The level of analysis in the pilot study approaches this on what we believe is a realistic basis - it is possible to demonstrate the implications for timber harvesting, but it may be unrealistic to assume we can predict the recreational response with any certainty.

5.0 RECREATION

The forest estate provides numerous opportunities for outdoor recreation. This includes consumptive recreation based on the fish and wildlife resources (fishing and hunting), as well as non-consumptive recreation including camping, hiking, sightseeing, automobile and snowmobile touring in season, firewood gathering, etc. At present the total use in these various types of recreation is estimated at some 12,000 recreation days per year.

In planning for recreation as an important part of the forest estate's output, the basic issue of how to measure output arises. The simplest and most readily understood measure of output is perhaps the recreation day. While this may be an adequate measure for recreation planning, per se, it does not meet all of the requirements for planning integrated management of the forest estate. The recreation day fails as a measure of output when choices must be made between alternatives (recreation or grazing, recreation or timber harvests,etc.) which are measured in different units. It is customary to try to express each alternative in terms of its "value", in the sense of monetary value, so that rational choices can be made (as illustrated in Figure 1 dealing with cattle and elk).

The problem of determining the monetary value of recreation is that, due to a tradition of offering recreation opportunities of the type available in the forest estate to participants free of charge[14] they have in effect become "non-marketed" resource uses. The lack of market derived indicators of the value of outdoor recreation does not mean that opportunities have

14. At most, nominal charges are levied in the case of sport fishing and hunting, for which licenses must be purchased. These charges do not relate to the amount of recreation "consumed" by the licensee, however.

no value, however, and since the late 1950s there have been efforts to develop methods to estimate what those values would be if the opportunities were marketed[15].

Given the results of such research, various management agencies are in the habit of using per day estimates of recreation value in resource management planning. In the United States the Forest Service values recreation at from $6.50 to $12.50 per visitor day, depending on location and other factors.[16] In British Columbia an early guide to benefit cost analysis suggested that site specific recreation values be developed for use in project analysis, and that standard values per day be used only when specific estimates could not be prepared with available time and funds[17].

We obviously do not have time or funds to develop site specific recreation values for the pilot study. And we are reluctant to assign "standard" values per day for several reasons. First, the limitations of these estimates of value are often overlooked when information is reduced to summary form for decision making purposes. Those to whom such information is presented have to fully understand that the basis for the estimates of recreation value differs from what underlies the more usual estimates of value. Economic values attributed to recreation are derived from hypothetical statements (or estimates) of what recreation is "worth" to the participant, and do not reflect the kinds of business transactions that are normally thought to lie behind estimates of economic value - as would be the case for the value of timber or grazing from the forest estate. This distinction is often lost in presentation, when nonmarket and market values are mixed together. For the pilot study it was felt to be prudent not to take the risk that assigning dollar values to recreation days would confuse the decision or choice process when market and nonmarket values are involved.

Second, although researched for several decades, there are still serious questions about the validity of the values that are derived for nonmarket activities. A given outdoor recreation opportunity may be assigned widely varying values, depending on the method that is used

15. The initial papers were: Trice, A.H. and S.E. Wood. 1958. "Measurement of Recreation Benefits", Land Economics, Vol. 34, August; and Clawson, M. 1959. Methods of Measuring the Demand for and Value of Outdoor Recreation, Reprint no. 10, Resources for the Future, Washington, D.C.

16. As cited in Bowes and Krutilla, Multiple-Use Management: The Economics of Public Forestlands.

17. Environment and Land Use Secretariat, Province of British Columbia. 1977. Guidelines for Benefit-Cost Analysis. Victoria.

to estimate value (differences of factors of 2 or 3 are not uncommon). Since it is difficult to test the validity of such estimates, we are reluctant to adopt the process in the pilot study and implicitly accept a set of value estimates.[18]

Finally, for the kinds of management decisions required on the forest estate it is not the average value of a day of any particular type of outdoor recreation that is important, but the marginal value of having more or less recreation, or of having the quality of the recreation experience affected in some way by timber harvesting or other resource uses. Economic theory suggests that after a point the marginal value of a product such as outdoor recreation will decline as more is consumed, which has been demonstrated in some studies[19], but we have little to suggest what these relationships would be for the forest estate.

For these reasons we have chosen not to include estimates of the direct value of outdoor recreation opportunities in the pilot study. The analysis is limited to estimating the number of days of different types of recreation that are likely to be realized under each of the forest management options. What this does in effect is reverse the question facing the decision maker from "How much is it worth?", to "Is it worth it?". Thus if the analysis indicates that in order to attain a certain number of days of outdoor recreation (say deer hunting) direct management costs of $X must be incurred, and additional costs in terms of timber harvests or livestock grazing foregone are required, the question then is whether it is in society's interest to incur those costs in return for that amount of recreation?

We have not felt it to be realistic to differentiate between the basic "timber driven" options for the forest estate in terms of opportunities for outdoor recreation, with the exception of a modest effect in the case where shelterwood harvests are assumed. In two cases where the management emphasis is on other resources a significant recreation response is assumed,

---

18. "The validity of these non-market values has become a major question for economists and policy makers. Decision makers are often reluctant to include non-market values, as they feel that they are too hypothetical in nature. Since there are no true values to compare with, testing the validity of the nonmarket values becomes a difficult task." Adamowicz, W.L. 1988. "Behavioral Implications of Nonmarket Valuation Models", Canadian Journal of Agricultural Economics, 929-939.

    ".... there are as yet important methodological issues that need to be resolved before the contingent valuation method is ready for routine implementation." Mitchell, R.C. and R.T. Carson. 1987. How Far Along the Learning Curve is the Contingent Valuation Method?, Resources for the Future, Washington, D.C.

19. Johnson, N.S. and R.M. Adams. 1989. "On the Marginal Value of a Fish: Some Evidence from a Steelhead Fishery", Marine Resource Economics, Vol 6. pp. 43-55. The analysis reported in this paper suggests that the marginal values of sport caught fish are significantly lower than average values.

however, with user days doubling to 24,000 per year in one of those. It is by comparing the other indicators for this option with those from the timber driven options that decision makers can then frame the question, as above, as to whether the gains in recreation opportunities justify the tradeoffs that are required.

6.0 MINERAL RESOURCES

The forest estate is Crown land, in a mineral-rich region of the province. There has been some exploration and staking on the estate, but there are no known plans for active mining at present.None of the options analyzed in the pilot study include mining development. That is not a judgment as to its probability, but rather a lack of realistic information on which to include such a prospect.

In this forest estate, as elsewhere in the province, should a property be proposed for mine development there is an established review process to be followed. In the event that a mine would occupy a significant land area in the forest estate the implications for timber, range, fish, wildlife and other resources would be assessed in the review process, and it is presumed that the mine would not be approved unless the benefits from its development outweighed the costs or losses imposed on other resource uses.

If a mine were approved within the forest estate, the area which it occupied would in effect be removed from the estate and managed separately. The management plan for the forest estate would have to be reformulated in light of its redefined boundaries and potentials at that time.

7.0 NON-USE VALUES

Under the heading of non-use values we discuss two aspects of forest estate management. The first encompasses those values which may be supported by the forest estate, but do not depend on direct use of its resources referred to as "preservation values". The second is the concept of bio-diversity.

Preservation Values

An early article by Krutilla[20] is generally recognized as providing the initial clear statement of non-use values that may accrue from natural resources. These are values quite separate from those arising from direct use of resources, and there have been many subsequent efforts to describe and categorize them. Four categories - "preservation", "option", "existence" and bequest values were recognized in one study[21]. Other descriptions that have been applied to these non-utilitarian values include potential use/option value, existence and stewardship value, preservation for scientific and educational purposes, and vicarious consumption in the form of enjoyment from knowing that others are able to use resources.

There has been little quantitative research into such values, but it is generally argued that they are relevant in making decisions about rare or unique resources, and wilderness resources which exist in a largely undisturbed state and cannot readily be recreated. In the case of the forest estate used in the pilot study, which is already well developed for a variety of uses (timber, range, recreation), such values are not likely to be high or of significant weight in choosing between management options.

We do analyze one case, with a recreation oriented management focus, where a significant part of the estate is reserved from timber harvests. It may be the case for this option that the various forms of "preservation" value would be heightened, as compared to the other options where there is less scope for "non-use". In selecting between options we would expect the decision makers to give some weight to these values, although it would have to be in subjective terms only.

Bio-Diversity

The concept of maintaining bio-diversity as a goal in resource management has recently become somewhat of a "buzz word". Definitions or implications range from warning about the risks of monoculture cropping (forestry, agriculture), to the need to avoid activities that risk the extinction of species.

---

20. Krutilla, J.V. 1967. "Conservation Reconsidered", American Economic Review, vol. 57 (Sept.) pp. 777-786.

21. Walsh, R.G., J.B. Loomis & R.A. Gillman. 1984. "Valuing Option, Existence and Bequest Demands for Wilderness", Land Economics, February, 14-29.

Given the variety of tree species which are intended to be harvested and reforested within the forest estate, concerns about the risks from single species monoculture are not felt to apply. Although foresters may select within a species for desirable characteristics such as rapid growth, the selection of species to be planted will be determined by the characteristics of individual sites. Hence the species composition of second growth and successive forests will not differ significantly from that initially determined by natural selection within the unmanaged forest.

As for the protection of rare or endangered species, these tend to occupy special habitats or niches which are fairly easily recognized. Identification of such sites and provision for their protection is becoming a standard practice in developing forest harvesting plans. We assume that this would be done as a matter of routine under the kind of forest management agreement that would be developed for the forest estate.

Thus we would expect the various concerns raised under the rubric of "bio-diversity" to be addressed on the forest estate. It would seem to be an appropriate management function to conduct an inventory of the flora and fauna of the estate to identify rare or uncommon resources - arrangements for their protection might take a form similar to the ecological reserves that are fairly common throughout the province. We do not make explicit provision for this in the management options that are analyzed, however, as in most cases we expect the land area involved to be small and impacts on other resource uses to be minor. The potential contribution to bio-diversity is greatest in the one case where a significant portion of the estate is reserved from timber harvesting, and this could also be given subjective weighting in the process of selecting between the options.

APPENDIX IV

SCHEDULE FOR LEVELIZING INCOME FROM A FINITE SERIES OF CAPITAL PAYMENTS

APPENDIX IV

"INCOME CONTENT"

Life Expectancy of Resource	Discount Rate 0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.08	0.09
2	0	0.02	0.04	0.06	0.08	0.09	0.11	0.13	0.14	0.16	0.17
3	0	0.03	0.06	0.08	0.11	0.14	0.16	0.18	0.21	0.23	0.25
4	0	0.04	0.08	0.11	0.15	0.18	0.21	0.24	0.26	0.29	0.32
5	0	0.05	0.09	0.14	0.18	0.22	0.25	0.29	0.32	0.35	0.38
6	0	0.06	0.11	0.16	0.21	0.25	0.30	0.33	0.37	0.40	0.44
7	0	0.07	0.13	0.19	0.24	0.29	0.33	0.38	0.42	0.45	0.49
8	0	0.08	0.15	0.21	0.27	0.32	0.37	0.42	0.46	0.50	0.53
9	0	0.09	0.16	0.23	0.30	0.36	0.41	0.46	0.50	0.54	0.58
10	0	0.09	0.18	0.26	0.32	0.39	0.44	0.49	0.54	0.58	0.61
15	0	0.14	0.26	0.36	0.44	0.52	0.58	0.64	0.68	0.73	0.76
20	0	0.18	0.33	0.45	0.54	0.62	0.69	0.74	0.79	0.82	0.85
25	0	0.22	0.39	0.52	0.62	0.70	0.77	0.82	0.85	0.88	0.91
30	0	0.26	0.45	0.59	0.69	0.77	0.83	0.87	0.90	0.92	0.94
35	0	0.29	0.50	0.64	0.75	0.82	0.87	0.91	0.93	0.95	0.96
40	0	0.33	0.55	0.69	0.79	0.86	0.90	0.93	0.95	0.97	0.98
50	0	0.39	0.63	0.77	0.86	0.91	0.95	0.97	0.98	0.99	0.99
60	0	0.45	0.70	0.83	0.90	0.95	0.97	0.98	0.99	0.99	1.00
70	0	0.50	0.75	0.87	0.94	0.97	0.98	0.99	1.00	1.00	1.00
80	0	0.55	0.79	0.91	0.96	0.98	0.99	1.00	1.00	1.00	1.00
90	0	0.59	0.83	0.93	0.97	0.99	0.99	1.00	1.00	1.00	1.00
100	0	0.63	0.86	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00

Note: Figures are rounded to nearest hundredth

APPENDIX IV

"CAPITAL CONTENT"

Life Expectancy of Resource	Discount Rate 0%	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%
1	1	0.99	0.98	0.97	0.96	0.95	0.94	0.93	0.93	0.92	0.91
2	1	0.98	0.96	0.94	0.92	0.91	0.89	0.87	0.86	0.84	0.83
3	1	0.97	0.94	0.92	0.89	0.86	0.84	0.82	0.79	0.77	0.75
4	1	0.96	0.92	0.89	0.85	0.82	0.79	0.76	0.74	0.71	0.68
5	1	0.95	0.91	0.86	0.82	0.78	0.75	0.71	0.68	0.65	0.62
6	1	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.60	0.56
7	1	0.93	0.87	0.81	0.76	0.71	0.67	0.62	0.58	0.55	0.51
8	1	0.92	0.85	0.79	0.73	0.68	0.63	0.58	0.54	0.50	0.47
9	1	0.91	0.84	0.77	0.70	0.64	0.59	0.54	0.50	0.46	0.42
10	1	0.91	0.82	0.74	0.68	0.61	0.56	0.51	0.46	0.42	0.39
15	1	0.86	0.74	0.64	0.56	0.48	0.42	0.36	0.32	0.27	0.24
20	1	0.82	0.67	0.55	0.46	0.38	0.31	0.26	0.21	0.18	0.15
25	1	0.78	0.61	0.48	0.38	0.30	0.23	0.18	0.15	0.12	0.09
30	1	0.74	0.55	0.41	0.31	0.23	0.17	0.13	0.10	0.08	0.06
35	1	0.71	0.50	0.36	0.25	0.18	0.13	0.09	0.07	0.05	0.04
40	1	0.67	0.45	0.31	0.21	0.14	0.10	0.07	0.05	0.03	0.02
50	1	0.61	0.37	0.23	0.14	0.09	0.05	0.03	0.02	0.01	0.01
60	1	0.55	0.30	0.17	0.10	0.05	0.03	0.02	0.01	0.01	0.00
70	1	0.50	0.25	0.13	0.06	0.03	0 02	0.01	0.00	0.00	0.00
80	1	0.45	0.21	0.09	0.04	0.02	0.01	0.00	0.00	0.00	0.00
90	1	0.41	0.17	0.07	0.03	0.01	0.01	0.00	0.00	0.00	0.00
100	1	0.37	0.14	0.05	0.02	0.01	0.00	0.00	0.00	0.00	0.00

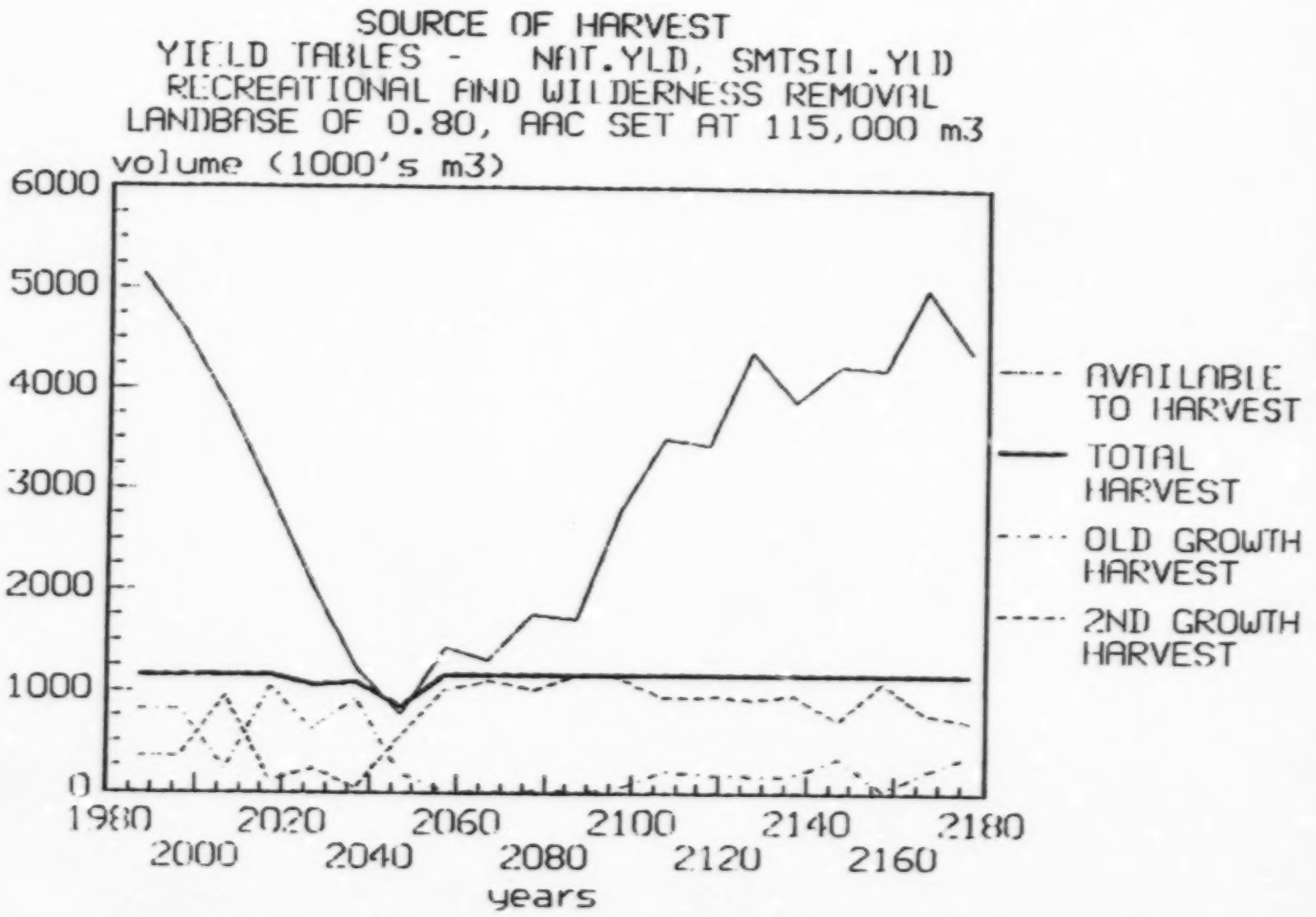
Note: Figures are rounded to nearest hundredth

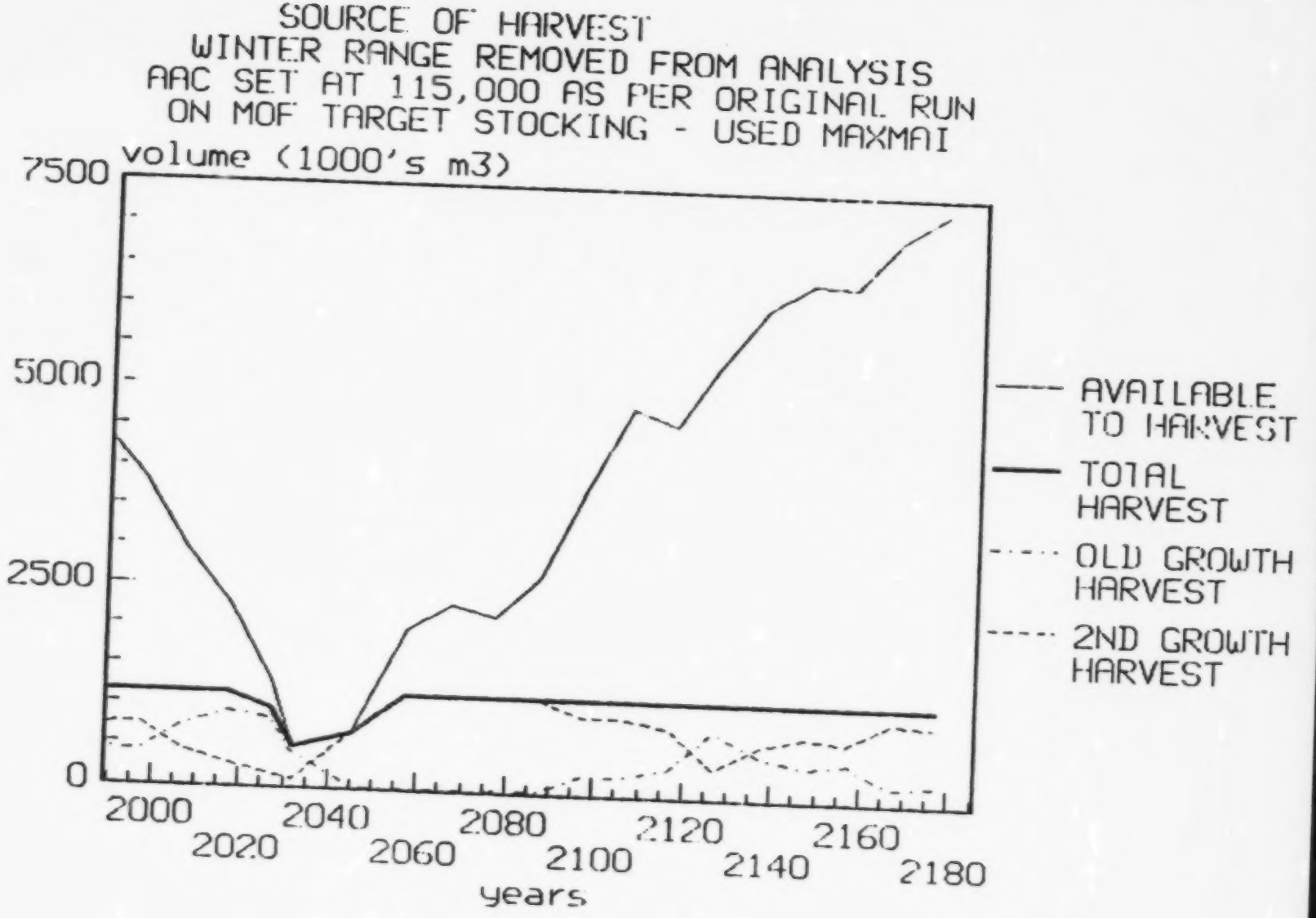
APPENDIX V

MAPS

APPENDIX VI

TIMBER REPLACEMENT ANALYSES FOR OPTIONS 11 AND 12


SOURCE OF HARVEST
YIELD TABLES - NAT.YLD, SMTSII.YLD
RECREATIONAL AND WILDERNESS REMOVAL
LANDBASE OF 0.80, AAC SET AT 115,000 m3
volume (1000's m3)
6000
5000
4000
3000
2000
1000
0
1980
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST


SOURCE OF HARVEST
WINTER RANGE REMOVED FROM ANALYSIS
AAC SET AT 115,000 AS PER ORIGINAL RUN
ON MOF TARGET STOCKING - USED MAXMAI
volume (1000's m3)
7500
5000
2500
0
2000
2020
2040
2060
2080
2100
2120
2140
2160
2180
years
AVAILABLE TO HARVEST
TOTAL HARVEST
OLD GROWTH HARVEST
2ND GROWTH HARVEST